RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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of what is probably infracapsular dye produces an umbrella over the superior pole. An excess of catheter is present in the bladder and can be traced to both catheters, suggesting that the pressure applied during their insertion was equal. The urologist stated that he encountered no difference in sensation in passing the two catheters. The phenomenon of penetration of the

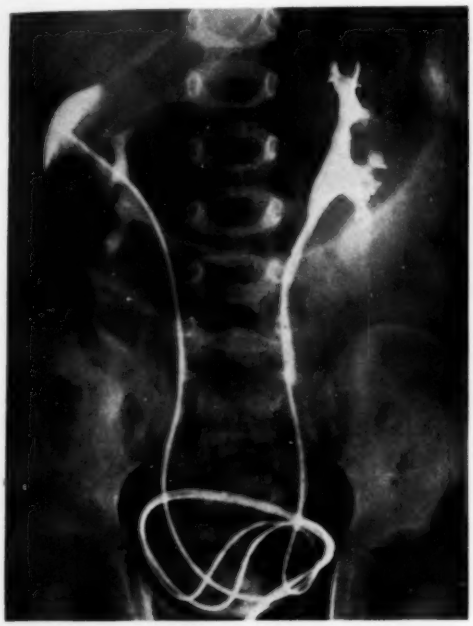

Fig. 2. Retrograde urogram in pyelonephritis. The left catheter distorts but does not penetrate the superior calyx; the right catheter has penetrated the diseased kidney substance. Note excess catheter from both sides coiled in the bladder.

parenchyma of the kidney by the ureteral catheter has been observed several times when examination has been done shortly after or practically during the course of an acute pyelonephritis.

Penetration of the kidney substance by the catheter is not necessary to produce the picture of extravasation of dye into the substance of the kidney. A preliminary film taken before the injection of dye in the case illustrated in Figure 3 showed the left catheter to have passed up to the perirenal fat, while the right catheter was at the level seen in the picture. It having

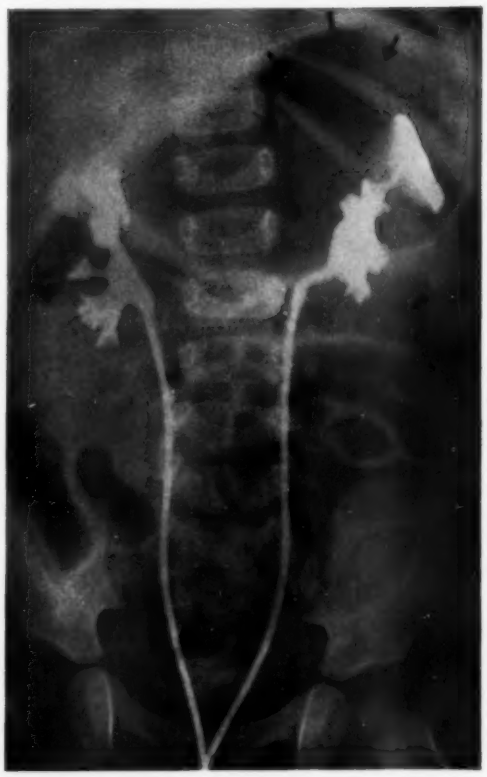

Fig. 3. Penetration of the left kidney had been recognized on a preliminary film and the left catheter has been partially withdrawn. The right catheter has not changed position. Dye has sought out the diseased area in the right kidney.

been recognized in the preliminary film that substance of the kidney had been penetrated, the left catheter was withdrawn several centimeters prior to the dye injection. The track of the catheter in its path through the left kidney is well shown, connecting the pelvis with the artificially increased subcapsular space. The pelvis is remote from the superior pole of the kidney, suggesting that a second pelvis is present. On the right side, however, where the catheter has not been advanced beyond the point seen in the illustration, extravasation has occurred about the superior calyx. This is not merely extensive pyelocanalicular backflow. This is a true extravasation into the substance of the kidney. Five days later, excretory urography confirmed the double pelvis-

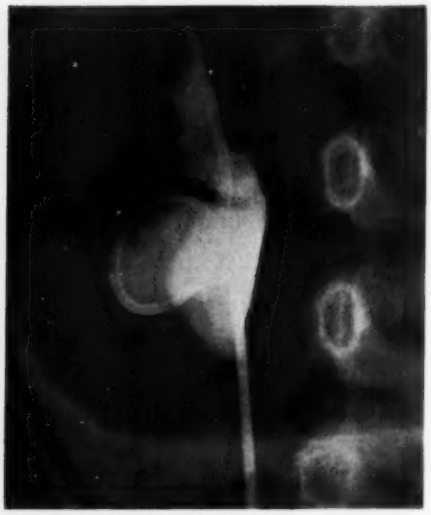

Fig. 4. Distortion of calyx without penetration. The force of introduction is indicated by the coil of catheter in the pelvis. No history of pyelonephritis.

double ureter deformity but showed no evidence of kidney disease.

It seems highly probable that the localization of the extravasation, whether it be produced by intrapelvic hydrostatic pressure or by mechanical penetration of the ureteral catheter, indicates a site of pathologic change in the parenchyma of the kidney in pyelonephritis. This penetration has thus far had no bad results in the patients examined. The dye is absorbed quickly, usually within an hour. In one patient, extravasation on one side alone was absorbed within an hour and was followed by an excretory urogram on the opposite side.

The normal renal pelvis can withstand considerable pressure and distortion (4), and although pyelocanalicular backflow, pyelosinus transflow, etc., can occur with excessive pressure, at no time do these abnormalities of dye distribution reach the proportions which are present in these patients. The left ureteral catheter seen in Figure 2 did not penetrate the calyx which it distorted, while the catheter on the right side cut through the renal substance with ease. Figure 4 illustrates a further example of distortion of a renal pelvis by a catheter without penetration, presumably because the fornix in which the tip of the catheter is lodged is normal. The illustration is from a retrograde urogram in a child who had hematuria of undetermined cause several days before the examination. The tip of the catheter is not only high in the fornix of the superior calyx, producing distortion, but the pressure in introducing the catheter was sufficiently great to cause the catheter to coil in the pelvis. Notwithstanding, in this child, who did not have a history of recent pyelonephritis, no penetration of the calyx occurred.

It has been recognized for some time that pyelonephritis is associated with areas of inflammatory reaction within the parenchyma of the kidney itself, even going on to abscess formation and perinephritis. The inflammatory reaction in the parenchyma of the kidney has been explained on the basis of hematogenous dissemination from foci elsewhere in the body, ascending infection either from the obstructed conduit system of the kidney or the lymphatics of the ureteral walls draining infection of the lower urinary tract, or direct extension from infection in the renal pelvis. Unless marked stasis is present, it is very unlikely that infection will spread in the direction counter to the flow of urine. If hematogenous dissemination always occurred, multiple lesions would be the rule, and there would be no reason to expect primary change in or about the fornices as described by Putschar (5). Putschar stated that stasis in the urinary conduit system produces retention first in the fornices, where it is probably an early sign of disturbed muscular coordination of the kidney pelvis due to inflammation and edema of the mucosa and muscularis. Bacterial growth is favored by stasis, and epithelial desquamation takes place. Following this, there is erosion of the mucosa of the fornix, with extension of infection into the deeper tissues. Adjacent to the fornix there are many vessels, veins, arteries, and lymphatics, in the sinus renalis, which pass between the pyramids to the

cortico-medullary junction. As infection passes from the eroded denuded fornix into the deeper tissues, these vessels pick up the inflammatory agents and pass them along to the deeper tissues of the kidney. With inflammatory reaction in the fornices and its adjacent sinus renalis as well as the renal parenchyma, it is easy to see how a catheter which by chance passes into a diseased fornix can penetrate into the renal substance and, if the renal substance is sufficiently softened by inflammatory reaction, directly to the kidney capsule. It will also explain why dye under equal hydrostatic pressure in all calices will tend to extravasate into the renal substance through fornices where such pathologic change has taken place. Probing the renal pelvis with catheters to identify sites of inflammatory reaction in children with pyelonephritis is not to be recommended even though the results in a small series have not indicated harm arising therefrom. In fact, until it can be proved that remote effects of damage do not develop, the observations may serve to deter examiners from attempting retrograde studies immediately following clinical pyelonephritis. When, however, in the course of retrograde urography, observations like these are made, an explanation is offered by the diagnosis of pyelonephritis.

NEUROGENIC UROPATHY

In certain children with urinary tract symptoms, roentgen examination discloses dilatation and elongation of the ureters, stasis of fluid within them, but no evidence of organic obstruction. These children are said to have neurogenic disturbances. It would appear that this classification is a wastebasket designation for cases in which the primary disease eludes our technics of detection. This group of patients merits serious study, preferably from a point of view not already biased by the tag "neurogenic." Certain cases, however, are properly called by this term, namely those showing congenital malformations of the spinal cord and neurologic deficit often associated with malformations of the lumbosacral spine. The observation of a spina bifida occulta cannot be accepted as proof that urinary tract abnormalities which are present are neurogenic in origin. True spina bifida occurs as frequently in asymptomatic children as in those with urinary tract disease. The urologist of necessity sees a disproportionate number of children with spina bifida *and* urinary abnormality, and naturally attempts to relate the two conditions. Until a neurologic deficit can be demonstrated, it is better to consider their association as an expression of simultaneously occurring malformations of the skeleton and the urinary tract. During early fetal life, for example, the ureters are disproportionately large. About the fourth fetal month, the muscular layers begin to develop in the ureteral walls from below upward and, with the acquisition of muscular tone, the ureters approach more normal proportions. Dilated atonic ureters, therefore, may result from a congenital deficiency in the ureteral musculature rather than in the nerve supply. Ureteral dilatation associated with congenital deficiency of the abdominal muscles may fall into this class. Adequate studies have not been made of intramural neural elements in so-called neurogenic ureteral disease comparable to recent studies in the large intestine in Hirschsprung's disease.[2]

The patient with the true neurogenic lesion usually has a large defect in the neural arches of the lower lumbar and upper sacral segments, as shown in Figure 5. This child had a spina bifida with meningocele and was operated upon early in life. She also had bilateral clubfoot, disturbances of sensation in the lower extremities, and gross motor difficulties. She was followed for several years, generally by the orthopedists because of the difficulties in locomotion, and did not come for careful pediatric investigation until it was observed that she was growing much more slowly

[2] Since presentation of this paper for publication, Swenson and associates have demonstrated a diminution of parasympathetic ganglion cells in the bladders of children with Hirschsprung's disease *and* dilatation of bladder and ureters (New England J. Med. **246:** 41–46, Jan. 10, 1952).

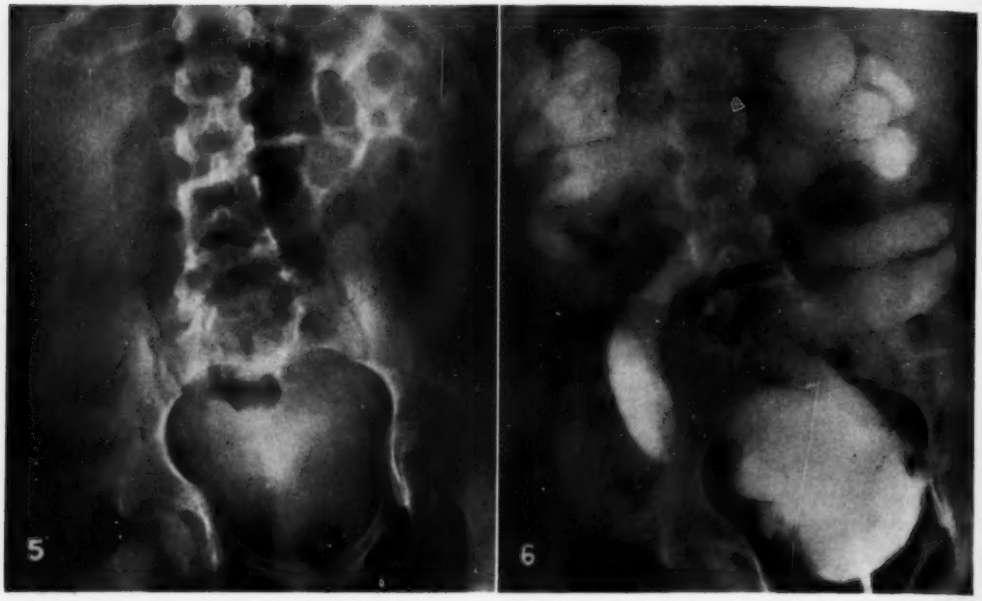

Fig. 5. Spina bifida with meningocele in an 8-year-old girl with neurologic deficit in the lower extremities. Slowing of growth; no genito-urinary symptoms.
Fig. 6. Cystogram for same patient. "Neurogenic" uropathy.

than was to be expected on the basis of her known physical disabilities. The child had poor bladder control but there was no history of kidney infection. The non-protein-nitrogen content of the blood was 57 mg. per 100 c.c. She was therefore examined by the simple technic of cystography, which is one of the most valuable and yet one of the simplest procedures in investigation of the anatomy of the urinary tract. This procedure is of particular value when there is reason to suspect, as for example, in the presence of an elevation of the non-protein-nitrogen content of the blood, that excretion of intravenously injected opaque dye will be poor. In this particular case, the introduction of 150 c.c. of 15 per cent skiodan into the bladder demonstrated the extent of the abnormality in the urinary tract and adequately explained the child's lack of growth (Fig. 6).

URETEROCELE

Of a more satisfying nature from the therapeutic standpoint is uretero-vesical junction obstruction produced by an organic lesion, particularly stenosis with ureterocele formation. A ureterocele is a herniation of the mucosa of the bladder into the lumen, produced by a congenital stenosis at the bladder end of the ureter. As urine builds up pressure in the intravesical portion of the ureter, the mucosa bulges inward, stretches, and ultimately produces a mucosa-covered, fluid-filled, cystic termination of the ureter which is called a ureterocele. Ureterocele is probably more frequent than is generally suspected, since its identification rests on either cystoscopic visualization or growth to the size where it produces a distinct filling defect in the dye-filled bladder. In all cases, there is a hydronephrosis of the ureter and kidney draining into the ureterocele.

Many excellent studies have appeared on this condition. One of the most recent, by Gross and Clatworthy (6), has furnished particular guidance in the evaluation of films of a two-year-old girl who was examined because of acute urinary retention occurring for the first time eight weeks

before admission to Children's Hospital (Cincinnati). Two recurrences associated with fever led to investigation of the urinary tract, and a tumor was found in the bladder on earlier examination at another hospital. At Children's Hospital, retrograde urography was attempted, but the tumor was so large that the ureteral orifices could not be identified. The mass appeared to have mucosa on its surface and suggested a large ureterocele to the examining urologists. Cystography (Fig. 7) demonstrated

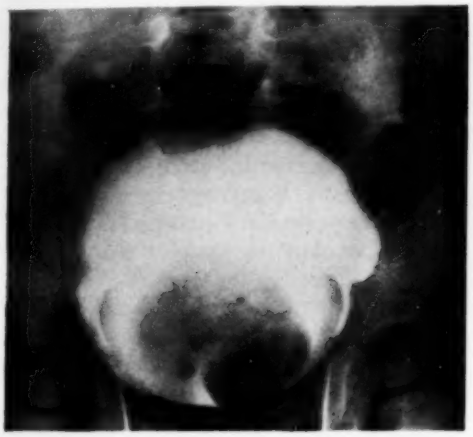

Fig. 7. Cystogram, showing large defect due to ureterocele which appears to arise from the left. On oblique films, reflux was observed in a left ureter.

a large filling defect apparently arising from the left side in the floor of the bladder. A small amount of reflux up the left side was observed in oblique films. An excretory urogram (Fig. 8) revealed marked hydronephrosis on the right side; in addition, the right pelvis was observed to be displaced laterally from its normal position. The right ureter was tremendously dilated, elongated, and tortuous. A double pelvis-double ureter deformity was present on the left side with some dilatation of the ureter which, in serial films, could be traced to the lower pelvis. As dye flowed into the bladder, the filling defect was again outlined.

Gross and Clatworthy pointed out that in approximately 50 per cent of their patients with ureterocele, a double pelvis-

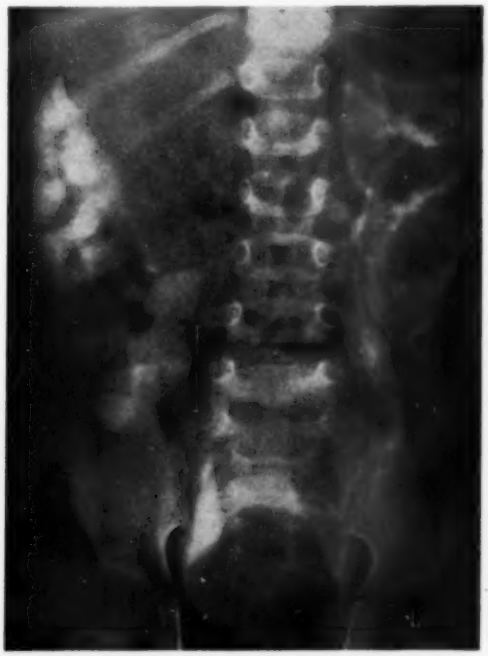

Fig. 8. Ureterocele with double pelvis-double ureter deformity. See text for discussion.

double ureter deformity occurred. Moreover, in every patient in whom a double ureter and double pelvis were present, the ureterocele arose from the ureter draining the upper pelvis. The application of this information led to the following analysis: the ureterocele, even though it appeared to, could not arise from the left, inasmuch as the left upper pelvis and its ureter were not appreciably dilated. The dilatation of the ureter from the left lower pelvis could be due to the ureterocele but, if so, it was an indirect effect of a ureterocele arising from the opposite side. The solitary dilated pelvis and ureter on the right could terminate in the ureterocele, but the lateral displacement had to be explained. Since a double pelvis-double ureter deformity was present on the left side, it seemed reasonable to assume that a similar deformity might be present on the right. If this were so, then an upper pole pelvis could be present, but so dilated that renal tissue had been completely destroyed and the ability to excrete dye

lost. The dilated upper pole pelvis could then displace the remainder of the kidney downward and to the right. Dilatation of the lower pelvis and its ureter could result from obstruction at its ureterovesical junction by pressure of the adjacent ureterocele arising from the ureter draining the upper pelvis. Operation confirmed

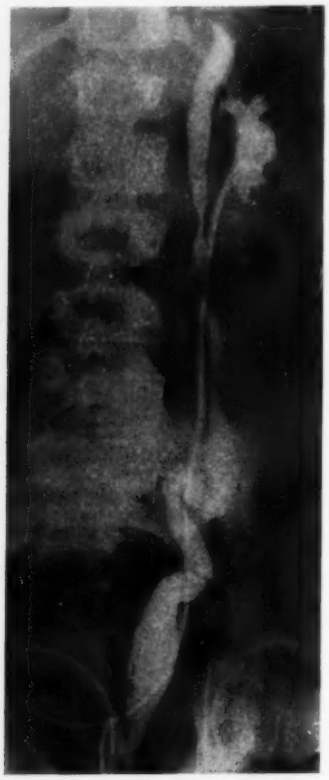

Fig. 9. Double pelvis-double ureter deformity with ectopic orifice in vulva, of ureter arising from upper pelvis.

the correctness of this reasoning. A double pelvis-double ureter deformity was present on the right side as well as on the left, and the upper pelvis was tremendously dilated, with practically no renal tissue except at its extreme tip. Following surgical treatment, an excretory urogram showed not only a decrease in the dilatation of the remaining right lower pelvis and ureter but an actual medial migration of the pelvis.

ECTOPIC URETERAL ORIFICES

When a double pelvis-double ureter deformity is present and the two ureters are separate throughout their entire length, the ureter draining the upper renal pelvis invariably enters the lower urinary tract at a lower level than the ureter draining the lower pelvis. Occasionally, the ureter from the upper pelvis empties into the urethra or into the vulva in the female or the perineum in either sex. In such cases, there are no proper reservoir or valve mechanisms to retain the fluid produced by the kidney, and dribbling invariably results. It is important clinically to point out that though the child may void normally, yet there is constant dribbling. The diagnosis is made by the demonstration of the double pelvis-double ureter deformity on excretory urography in a child presenting these symptoms. Identification of the ectopic orifice is often difficult. The patient whose retrograde urogram is shown in Figure 9 presented this characteristic story and had demonstrated a double pelvis-double ureter deformity on excretory urography. The source of her abnormal urinary flow could not be found in the perineum. During one of the attempts at retrograde urography the urologist explored minor crevices in the vulva and suddenly found an opening into which he was able to pass the catheter a distance of approximately 1.5 cm. Following this, a second catheter was passed easily into the normal ureter and, when retrograde injection was done, the diagnosis was conclusively confirmed. At operation, the child was found to have a separate blood supply to the upper pole of the kidney. A partial nephrectomy and ureterectomy were done, with complete cure of the symptoms.

POSTERIOR URETHRAL VALVES

In the consideration of infravesical obstruction in infants and children, posterior urethral valves should be emphasized as a remediable cause of severe kidney damage. The realization that the urinary

tract is at fault should not wait for the roentgen demonstration of the sequelae to this disturbance of urinary flow. The simple clinical observation of how the child voids often provides not only the indication that the urinary tract is abnormal but even a clue as to the diagnosis. In children with posterior urethral valves, the story is usually one of a poor urinary stream. The patient begins to void and then seems to have difficulty, small amounts of urine coming out, often in irregular spurts. At no time is there a real sustained stream.

Posterior urethral valves are usually thin mucosal folds running between the verumontanum and the wall of the urethra. They present no obstruction to the passage of a catheter or even a cystoscope from below and may therefore be missed by the endoscopist unless certain special precautions are taken, which need not be discussed here. When, however, the bladder empties its contents through the urethra, the mucosal folds fill, much as do the aortic valves of the heart during ventricular diastole, and bulge out toward the center of the urethra, producing an effective obstruction to the normal flow of urine. Since emptying becomes impossible, back pressure builds up quite rapidly, distention of the bladder takes place and when decompensation of the bladder occurs, the ureters are distended and the entire process of severe hydronephrosis and renal failure takes place.

The roentgen diagnosis of posterior urethral valves is most successful if they are visualized in their abnormal functional position—the way in which they interfere with the normal physiology of the bladder—by examination during the act of voiding. A case in point is that of a boy thought to have urinary tract obstruction, which could not, however, be found on careful endoscopic examination. He had therefore been carried along for years with the diagnosis of neurogenic bladder. Near the time of his terminal admission, an opportunity to re-examine him was presented, and cystography demonstrated

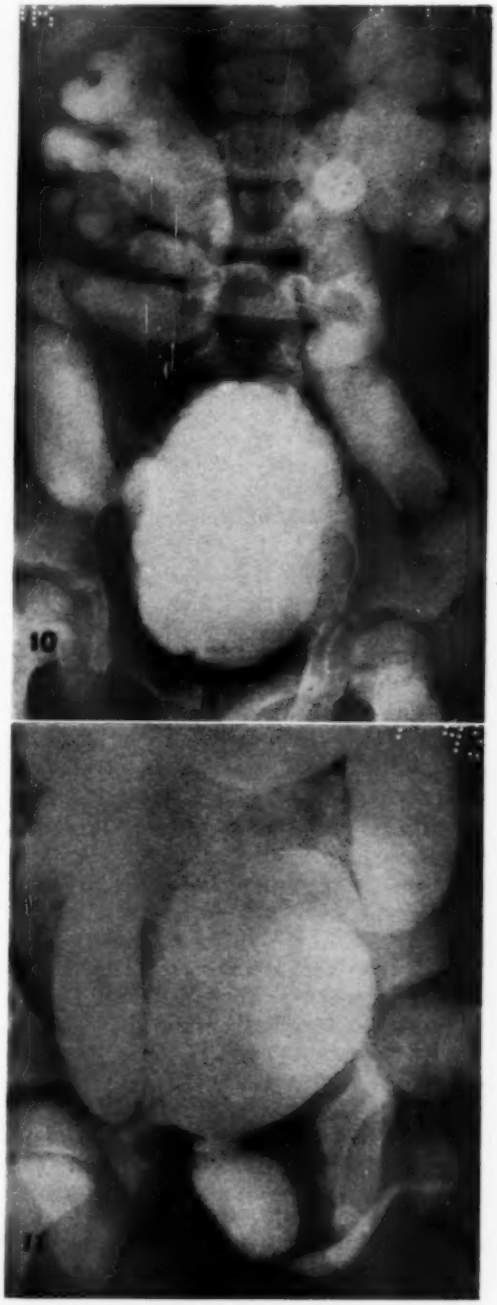

Fig. 10. Cystogram in boy with posterior urethral valves. The obstruction is not visualized. Note similarity to Figure 6.

Fig. 11. Voiding urethrogram after cystography. The characteristic dilatation of the posterior urethra is well shown.

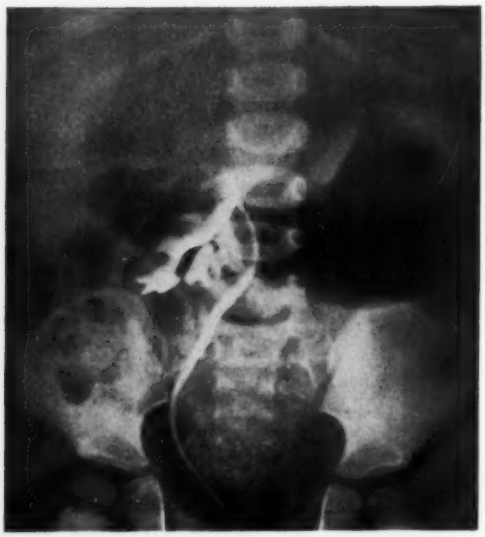

Fig. 12. Distortion and displacement of renal pelvis in Wilms' embryoma.

a dilated trabeculated bladder with many pseudo-diverticula (Fig. 10). Reflux had occurred up dilated, elongated, and tortuous ureters into markedly hydronephrotic renal pelves. The roentgen picture is quite similar to that seen in the child with a true neurogenic lesion (Fig. 6). There was no sign of obstruction, and the catheter which was passed into the bladder to introduce the opaque medium met with no obstacle either entering or upon withdrawal. With the child in the oblique position, however, and with exposure during the act of voiding (Fig. 11), the diagnosis of posterior urethral valve obstruction was easily made. The posterior urethra was markedly dilated and only a fine stream of urine passed through the point of obstruction to fill the distal urethra. A good-sized receptacle, an apron to protect the clothing, and some coaxing is all that is necessary to obtain films of this type even in very young children. If cooperation is impossible, the bladder can be distended to the point of spontaneous overflow, the child placed in the proper position, and exposure made as the urinary stream follows removal of the catheter.

MASS IN THE ABDOMEN

The three chief genito-urinary conditions associated with a mass in the abdomen are Wilms' embryoma of the kidney, neuroblastoma, and hydronephrosis. In each case, we are confronted with the child whose main manifestation is the presence of a mass palpable in the abdomen. Usually, the mass is found by the mother while bathing the infant or by the physician on a routine physical examination in an otherwise previously healthy child. The nature of the tumor is not elucidated by palpation through the abdominal wall. This procedure in itself may be hazardous, inasmuch as embryomas tend to invade blood vessels, and palpation can conceivably increase the chance of hematogenous dissemination of metastases.

A planned routine of study is often helpful for the rapid differentiation of the three conditions. Our first procedure upon admission of a patient with a mass in the abdomen is to obtain films of the abdomen, chest, skull, and the appendicular skeleton. Neuroblastomas notoriously metastasize to the liver and to bone, while Wilms' embryomas more frequently metastasize to the lung. The identification therefore of a tremendously enlarged liver or destructive skeletal changes would support the diagnosis of the former, whereas metastatic densities in the lungs would suggest the latter. In either event, the finding of metastases, particularly pulmonary or skeletal, speaks poorly for the ultimate outcome of the patient.

Our second procedure is to obtain an excretory urogram. As a general rule, we prefer to defer the manipulative procedures, such as retrograde urography, for use in the event that excretory studies prove unsatisfactory or non-diagnostic. This is seldom the case. The definitive roentgen features of the condition become obvious in most cases on the excretory urogram. Seldom does Wilms' embryoma so destroy the renal parenchyma that some functioning tissue does not remain. Therefore, a distorted renal pelvis will

usually be found on the side where a Wilms' tumor is growing. Displacement of the renal pelvis may be in any direction, although it has been said that lateral displacement is rare. The distortion (Fig. 12) indicates an intrarenal mass which not only displaces the kidney but also stretches and deforms its pelvis. This type of picture, when unassociated with skeletal lesions or massive enlargement of the liver, places Wilms' embryoma of the kidney as first on the list of probable diagnoses. Neuroblastoma of a large enough size to distort and displace the kidney and its pelvis to this degree seldom occurs without manifestations of skeletal destruction or massive hepatic enlargement.

Careful attention to the ribs and to the vertebrae in the region of the mass is extremely valuable in identifying the destructive manifestations of the posteriorly located neurogenic tumor. The majority of abdominal neuroblastomas arise from the adrenals. As a result, the displacement of the associated kidney is almost invariably downward. Moreover, the invasion of the kidney by the neuroblastoma does not usually produce the distortion seen in Wilms' embryoma, so that a relatively normal renal pelvis may be identified with only displacement of the kidney (Fig. 13). Displacement out of proportion to distortion is more likely to be the result of a neuroblastoma than of a Wilms' embryoma, particularly when the displacement is downward.

When a kidney becomes sufficiently hydronephrotic to produce a palpable mass, it often has reached the point of diminished function which precludes visualization by excretory urography. In such cases, the absence of dye density on the one side favors the diagnosis of hydronephrosis over the other two conditions. Before a definitive diagnosis can be made, retrograde urography is necessary if excretory urography is unsatisfactory. Figure 14 is a reproduction of an anteroposterior projection of the abdomen in a fourteen-year-old boy who had been perfectly

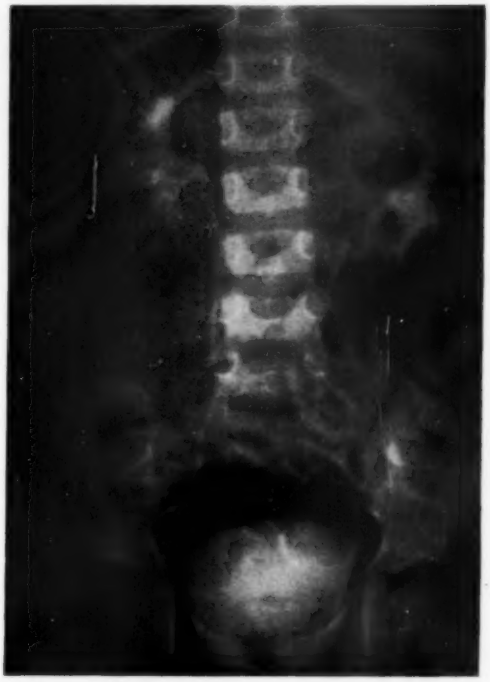

Fig. 13. Neuroblastoma arising from left adrenal. Note the displacement of the kidney without distortion of the pelvis.

healthy up to the day before admission. At that time, in the course of exercise, he suddenly experienced sharp pain in the right side of the abdomen. A physician was called and discovered a large mass which almost completely filled the right flank. At Children's Hospital, no lesions were found in the chest or skeleton, and an excretory urogram was attempted (Fig. 15). The only dye which could be conclusively identified were the several collections well over to the right side of the abdomen. It was thought that these might represent dilated calices, but distortion of the pelvis could not be excluded, and a retrograde urogram was obtained (Fig. 16). As soon as the catheter entered the region of the mass, the diagnosis was obvious by the drainage of clear urine from the tremendously hydronephrotic kidney. However, 300 c.c. of skiodan was introduced before the size and nature of the tumor mass was conclusively seen.

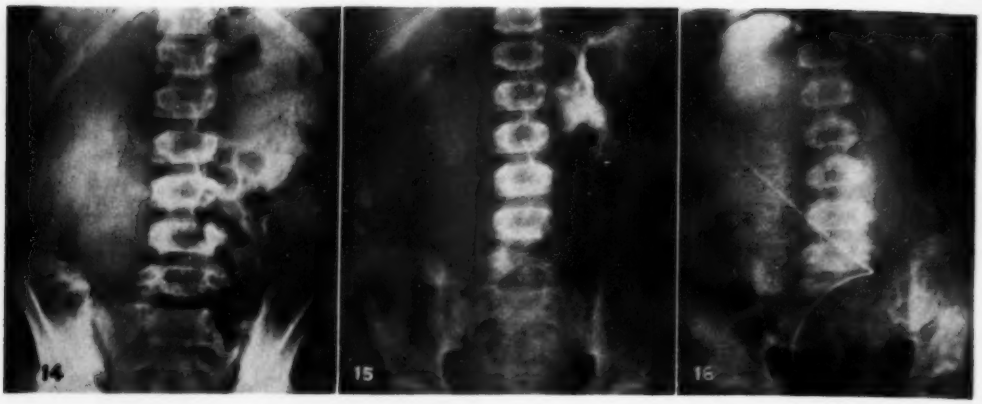

Fig. 14. Case of a 14-year-old boy with sudden pain in the right side. A mass of water density fills the entire right flank.

Fig. 15. Excretory urogram in same case. Hypertrophied (?) left pelvis. Probable hydronephrosis on right. Retouched.

Fig. 16. Retrograde urogram in same case. Proved hydronephrosis.

The importance of early diagnosis in a child who demonstrates a mass in the abdomen is indicated by the results of therapy, particularly combined surgical and roentgen therapy in children with neuroblastomas and Wilms' embryomas. In a recent series (7) of Wilms' embryomas treated between 1940 and 1947, 18 of 38 patients were alive. This was an over-all probable cure-rate of 47 per cent. When children under one year of age were considered, an 80 per cent probable cure-rate was obtained. Farber (8) had previously described 10 of 40 children with neuroblastoma who were alive and well three to eight years after diagnosis, removal of the primary tumor, and/or irradiation. The curability of a unilateral hydronephrosis is obvious.

SUMMARY

The failure to grow, the presence of an abdominal mass, and clinical signs of urinary system abnormality are the most common indications for roentgen examination of the urinary tract in infants and children. Technics used in adults are applicable regardless of the patient's size. A series of urologic problems in pediatric x-ray diagnosis is discussed. Penetration of renal parenchyma by the catheter or dye during retrograde urography in the course of acute pyelonephritis is thought to indicate sites of inflammatory reaction. The diagnosis of neurogenic uropathy should not be made on the basis of a spina bifida occulta unless a neurologic deficit can be demonstrated. The diagnosis of ureterocele, ectopic ureteral orifices and posterior urethral valves is discussed, and the differential diagnosis of Wilms' embryoma, neuroblastoma and hydronephrosis is developed. Examples of the several conditions are described and illustrated.

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SUMARIO

Problemas Urológicos en el Diagnóstico Roentgenológico en Pediatría

La falta de desarrollo, la presencia de una tumefacción abdominal y los signos clínicos de anomalía del aparato urinario constituyen las tres indicaciones más comunes para el examen roentgenológico del aparato urinario en las criaturas y niños mayores. En general, cabe emplear los mismos procedimientos diagnósticos que en los adultos. Este trabajo versa sobre el examen roentgenológico, haciendo hincapié en procedimientos sencillos y prácticos y en estados remediables.

En la evolución de una *pielonefritis aguda*, la penetración del parénquima renal por el catéter o el medio de contraste, con la producción de una imagen semilunar, lateralmente convexa, parece indicar el asiento de una reacción inflamatoria.

No debe hacerse el diagnóstico de *uropatía neurógena* a base de una espina bífida, a menos que pueda descubrirse una deformación neurológica. El enfermo con verdadera lesión neurógena suele tener una gran deformación en los arcos neurales de los segmentos lumbar inferior y sacro superior.

El *ureterocele*, al alcanzar tamaño suficiente, produce un nicho bien definido en la vejiga llena de colorante. En todos los casos, hay hidronefrosis que desagua en el ureterocele. En más o menos 50 por ciento de los enfermos, hay además deformación en pelvis-uréter dobles.

Las *válvulas ureterales posteriores* se descubren mejor por el examen durante la micción.

Una tumefacción abdominal puede indicar *embrioma de Wilms* en el riñón, *neuroblastoma* o *hidronefrosis*. El diagnóstico diferencial de esos estados aparece discutido, basándose en la presencia de metástasis y localización de las mismas, distorsión y desplazamiento del riñón y trastorno de la función renal.

Descríbense y reprodúcense ejemplos de los estados discutidos.

Clinical Experience with Irradiation Through a Grid[1]

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TO DECREASE the effects of x-rays on the skin when large fields are used to reach a deep-seated cancer, Alban Köhler (1) in 1909 had devised what has been termed "fractionation of the x-ray dosage in space." This was done by placing on the skin a steel wire net, the openings of which were 2 mm. wide and the wire proper 1 mm. in thickness. Köhler administered massive doses, ten to twenty times the total dose usually given at that time through a conventional open field. Healing of the skin was initiated in and extended from the surrounding relatively unscathed normal skin. In experimental radiobiology in 1931 (2) and 1938 (3*a*), doses of 25,000 r and 120,000 r without a grid were found to be inhibitory and lethal respectively to the proliferation of normal tissue *in vitro*, the cancericidal dose *in vivo* being 24,000 r in air (3*b*). In the above case, the *optimum* dose without a grid enters the tumor-bearing area, while in the grid method *only 40 per cent* of the 24,000 r in air, or 9,600 r in air, enters the tumor-bearing area to produce a lytic effect. In 1933 Frank Liberson (4) introduced the reciprocal, perforated screen made of lead 2 mm. in thickness with round apertures 3 mm. in diameter. Haring (5), in 1934, used grids made of lead, and Grynkraut (6), in 1935, employed grids of lead with aluminum foil lining.

In the author's experience, none of the grids enumerated above served to safeguard the skin from the impact of large x-ray doses in cases of deep-seated tumors: first, because of the absorption in the skin of considerable quantities of characteristic secondary rays from the lead; secondly, because of a disproportionate ratio of open (irradiated) to covered (non-irradiated) zones. This resulted in tipping the scales in favor of destruction as against regeneration in the normal tissues.

By adopting lead-rubber as the material out of which the grids were fashioned, thus eliminating the secondary rays from lead (7), and by empirically establishing the proportion of open to covered sections in the grid at 40 to 60 per cent (8, 9), the author began to approximate the goal he set for himself, namely, the sterilization of large, deep-seated tumors. The apertures in the grid measured 1.5 cm., 1 cm., and 0.5 cm. square or in diameter. It was further proved empirically that placing the grid in the same position at each treatment constituted an advantage over the alternating method, in that optimum doses could thus be delivered. The average daily dose, corresponding to the volume, depth, and sensitivity of the tumor, ranges from 400 and 600 to 800 r in air, the total dose through a single field being 10,000 r in air with a 20 × 20-cm. grid and 12,000 r in air with a 10 × 15-cm. grid. The smaller the volume of tissue irradiated, the higher the total dose. Thus, in some sites, *e.g.*, the cervical region, to avoid cross-firing one may attain a cancericidal dose through a single field by gradually narrowing the port of entry as the tumor regresses. With the larger grids, a dose of 10,000 r in air, through a single field, may be adequate to produce the desired lytic effect, as in the case of carcinoma of the lung cited below (p. 340). In the absence of such an effect, when cross-firing through opposing portals, the exit dose must be taken into account, as it amounts with a 6 × 8-cm. grid to approximately 4,000 r_d and upward at 6 cm., to 2,000 r_d and upward at 10 cm., to 1,000 r_d and upward at 15 cm., and to 500 r_d and upward at 20 cm.

[1] Presented in part at the Thirty-Sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950.

With 10 × 10-cm., 10 × 15-cm., and 20 × 20-cm. grids, the exit dose will be correspondingly higher.

The adoption of small portals was dictated by the physical measurements carried out by Glöcker (10) and Mayneord (11). These measurements proved that a reduction in back-scatter occurs when the portals are made progressively smaller. On the basis of the principles enunciated by Coutard that the normal tissues must remain inviolate while the tumor is irradiated, and the early (1941) investigations of Jolles (12, 13) with the aid of a grid, which proved that reaction to radiation becomes minimal when the normal tissues can exert their maximum protective role, the author began in 1943 to increase the daily dose.

The grid was used only in tumors of large volume, namely metastatic carcinoma in regional lymph nodes, extravesical extension of carcinoma of the urinary bladder, carcinoma of the lung, esophagus, and extrinsic larynx, advanced intraoral carcinoma, radioresistant Hodgkin's disease, and inoperable brain tumors. In these, with irradiation by the conventional method, the limits of skin tolerance would soon be reached because of the extent of the volume or area irradiated (14), the lower tolerance being due in the main to the greater energy absorption in the skin (11, 15). Optimum doses in these cases were not accompanied by radiation sickness or blood changes.

The skin reaction to x-ray irradiation through a lead-rubber grid, when the entire treatment is delivered through a single field, at daily intervals, begins with a faint erythema, which gradually increases in intensity until, at the middle of the course of treatments, the pattern of the grid becomes sharply defined on the skin. A progressive spread of erythema to the skin under the opaque sections of the grid follows. At the end of the treatment, the pattern of the grid becomes less and less visible and a uniform redness supervenes. Confluent desquamation and denudation develop seven to eight days following completion of irradiation. Healing is initiated in the covered islands of skin under the grid and is complete four to ten weeks from the date of cessation of treatments.

Deviation from the above pattern of skin reaction will occur when treatment is administered two or three times a week.

Intraoral, pharyngeal, and laryngeal epithelitis is never severe when the range of dosage per treatment does not exceed the figures given above. The time of its appearance will vary according to the dose and the treatment interval.

CLINICAL EXPERIENCE

The author, with the aid of a lead-rubber grid, has endeavored to extend the range of x-ray therapeusis to tumors hitherto considered irresponsive to irradiation, *i.e.*, to large-volume and radioresistant cancer.

The method of application is clinical. This implies that the state of well-being of the patient is of paramount importance since in order that the greatest benefit may be derived from the treatment, the local and general systemic reactions must be the guide posts in determining the size of the dose and the interval between treatments. By careful observation from day to day, one will learn to read these signs and will be able to apply the maximum safe doses commensurate with the patient's general physical condition, in proper chronological order.

The grid should be placed in exactly the same position at each treatment and should be slightly larger than the visible and palpable dimensions of the lesion so that the whole tumor will be included within the field of treatment.

Two hundred patients received x-ray therapy with the use of a lead rubber grid between 1943 and 1951, of whom 102 were able to complete the treatment. The results obtained in these cases are tabulated here according to the degree of palliation. The percentages signify the degree of resolution of the visible and palpable disease. The 100 per cent cases

are those in which there has been freedom from symptoms from the completion of irradiation to the present time. The 75 and 50 per cent cases represent patients with one or more areas of involvement who have been relatively more comfortable since undergoing treatment by this method.

In the 200 cases treated, no radiation sickness or blood changes were encountered, nor have any deleterious effects on bone been observed, since the small apertures of the grid, by reducing the volume of tissue irradiated, greatly limit the quantity of secondary radiation. Bone absorption, for this reason, is much less than in conventional roentgen therapy.

One patient, treated in 1944 for a carcinoma of the anus, received 12,000 r in air in ten treatment days, over a period of thirteen days, and has now survived, without recurrence, for six years.

A patient with carcinoma of the vulva with metastases to the left inguinal region, treated in 1948, received 7,200 r in air to the vulva and 21,000 r in air through the left inguinal region. She has survived without recurrence for four years.

A carcinoma of the pyriform fossa with metastases to the right cervical lymph nodes was treated with a 7 × 7-cm. lead-rubber grid 8 mm. in thickness with square apertures, 1.0 × 1.0 cm. This grid was narrowed to 5 × 5 cm. during the last five treatments. The over-all period of irradiation was forty-eight days, with a total of fourteen treatment days. A total of 20,500 r in air was delivered through the right lateral neck, centered on the lesion in the fossa, with the metastatic node included in the field. To date (February 1952) the patient has survived fourteen months.

A postoperative irresectable epidermoid carcinoma of the right lung was treated through a 20 × 20-cm. lead-rubber grid 8 mm. in thickness with 1.0 × 1.0-cm. apertures. A total dose of 10,000 r in air was delivered through a single field in ten treatment days in a period of four weeks. The patient is without recurrence thirteen months later, with minimal fibrosis.

TABLE I: RESULTS IN 102 PATIENTS IN WHOM GRID THERAPY WAS COMPLETED

Site or Type of Cancer	Response to Treatment		
	100%	75%	50%
Intraoral, with regional metastases	5	2	4
Vulva, with regional metastases	1 (4 yr.)	..	1
Bladder, with extravesical extension	..	3	2
Nasopharynx, with bilateral regional metastases	..	1	1
Radioresistant Hodgkin's disease	..	..	3
Breast, with regional metastases	1 (5 yr.)	1	10
Parotid, with regional metastases	1	..	..
Intrasellar neoplasm	..	1	..
Fibromyxosarcoma of the thigh and lower abdomen	..	1	..
Ovary, with metastases	1	1	3
Antrum and paranasal sinuses	2	..	..
Extrinsic larynx, with regional metastases	1	..	4
Stage IV carcinoma of the cervix	3	25	2
Lung	7	5	3
Desmoid tumor	..	1 (5 yr.)	..
Carcinoma of anus	1 (6 yr.)	1	..
Osteogenic osteolytic sarcoma of pelvis	..	1	..
Rodent ulcer of face	1	..	..
Metastatic cervical nodes, primary in auricle	1	..	..
Postoperative recurrent carcinoma of stomach, with peritoneal and umbilical metastases	..	..	1

The radiation quality in all the above cases was 0.9 mm. Cu h.v.l., 50 cm. T.S.D., 10 ma., 27.5 r per minute.

CONCLUSIONS

Advanced carcinoma of large volume has been found to respond more readily when roentgen radiation is applied through a lead-rubber grid, as adequate quanta can be delivered safely across the barrier of normal tissues. This is explained by a reduction in the volume of tissue irradiated, greatly limiting absorption of secondary radiation in the skin and thereby raising the rate of transmission. The grid technic makes possible the delivery of optimum doses, causing lysis of the tumor but permitting ready recovery of the normal tissues. The recovery factor is inherent in the permanently protected skin. No x-rays reach these covered areas directly through a lead-rubber grid 8 mm. in

thickness, except those scattered back by x-ray diffusion. Healing is initiated here and extends to the bordering squares or circles. The total dosage corresponding to the size of the field, in irradiation through a grid, is therefore predicated on a maximum safe dose, to wit, 2,500 r in air, which the covered areas will readily tolerate without undergoing permanent connective-tissue changes which would interfere with their recovery, upon which the whole mechanism of healing is dependent.

Upon this latter fact, as well as other potent clinical considerations—nutritional status, anemia, infection—will depend the ultimate success of treatment with this method. The selection of the dose will therefore be gauged by its relative effect upon the normal tissues, which must remain inviolate under all circumstances. Changes in blood vessels and lymphatics causing obliteration of their lumen, thereby plugging up the channels through which tumor debris is removed, are disastrous when they occur in the process of irradiation.

To avoid these pitfalls, the local and general systemic reactions of the patients must be the guiding posts in determining the size of the dose and the intervals of treatments. It is, therefore, incumbent on the radiotherapist to observe all patients under treatment with a grid with the utmost care. X-ray therapy through a grid is not a plan devised *a priori*, to be followed irrespective of the local and general condition of the patient. We cannot stress too emphatically the importance of the presence of a trained radiotherapist at each treatment. Grid therapy must never be carried out according to prescription, by a technician. The local and general response of the patient to treatment must be evaluated on a day-by-day basis by a trained radiotherapist.

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(*Para el sumario en español, véase la página siguiente*)

SUMARIO

Observaciones Clínicas con la Irradiación a Través de una Rejilla

En el tratamiento de los carcinomas profundos usóse una rejilla de plomo-caucho de 8 mm. de espesor, en la que la proporción de espacios abiertos y cerrados es de 40 y 60 por ciento, respectivamente. La rejilla es un poco mayor que las dimensiones visibles o palpables de la lesión por tratar y se coloca exactamente en la misma posición para cada tratamiento en un caso dado.

Los carcinomas avanzados muy voluminosos respondieron, según se observó, favorablemente a dicha técnica, pues pueden llevarse así inocuamente dosis adecuadas a través de la valla creada por los tejidos normales. La explicación ofrecida es que, por reducirse el volumen del tejido irradiado, limítase considerablemente la absorción de radiación secundaria en la piel y se eleva la proporción de transmisión.

La rejilla permite, pues, la entrega de una dosis lítica al tumor a la vez que permite la reposición de los tejidos normales. El factor reposición es inherente en las zonas de piel protegidas permanentemente por la rejilla. La cicatrización comienza allí y se extiende a las zonas circundantes irradiadas.

La selección de la dosis en el caso dado se basará en su efecto relativo sobre los tejidos normales, que deben permanecer incólumes en todas las circunstancias. Las reacciones locales y generales del enfermo serán los indicadores que determinarán la dosis y los plazos entre tratamientos. Por consiguiente, es de la mayor importancia que todos los tratamientos sean administrados en presencia de un radioterapeuta avezado que pueda justipreciar las respuesta a base diaria.

De 104 enfermos tratados con la técnica descrita, 25 habían permanecido sin síntomas desde que terminó la irradiación hasta la fecha de esta comunicación. Los intervalos más largos eran de cuatro, cinco y seis años. En los casos restantes, obtúvose alguna paliación calculada en 75 y 50 por ciento.

Recent Clinical Experience with the Grid in the X-Ray Treatment of Advanced Cancer

Preliminary Report

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WHEN ALL SITES and types of cancer are included, the cure rate from currently accepted methods of treatment does not exceed 25 per cent. This means that about 75 per cent of all cancer victims must be considered incurable and can be treated only palliatively for prolongation of useful life or relief of symptoms, or both. The value of radiotherapy as a palliative agent is not universally appreciated. There is often a lack of interest in the hopeless or incurable patient and either no active treatment is given or only meaningless token therapy.

Recently, renewed interest has been displayed in the use of grids for roentgen therapy of advanced cancers. Grids have been used in roentgen therapy since 1909, when Alban Köhler (1) made his first report. Later, in 1933, Liberson (2) suggested the use of a metallic lead grid and worked out the biological and physical aspects which are, for the most part, valid to this day. Others, including Haring (3), Grynkraut (4), and Jolles (5) have also suggested the use of grids, all to the same end, to improve the dose to the tumor without compromising normal tissues. Biophysicists have repeatedly indicated a greater normal tissue tolerance to ionizing radiation through small portals in experimental animals (6), and in the recent work with grids it has been shown that this increased tolerance may be obtained through the use of large aggregates of small portals separated by relatively opaque areas.

The most recent clinical report on this subject in this country was made in June 1949, by Dr. Hirsch Marks, who read a paper on the use of a grid with roentgen therapy before the Radiological Section of the American Medical Association in Atlantic City. In February 1950, Marks presented some of his treated patients at the Mount Sinai Hospital, New York. Two features which impressed us at this time were the degree of palliation obtained and the tolerance of normal tissue for doses of x-ray in excess of any hitherto employed on human material.

Marks substituted a lead-rubber grid for Liberson's metallic one and employed the same grid openings throughout the treatment. Furthermore, he increased the total dose far beyond that suggested by Liberson. Marks' (7) suggested dose in February 1950 was 24,000 r in air, in daily fractions, in a over-all period of twenty-eight days, through a grid in which the proportion of closed to open spaces was 40 to 60 per cent. More recently he has recommended a total dose of 10,000 r in air with a 20 × 20-cm. grid and 12,000 r in air with a 10 × 15-cm. grid.

Loevinger (8), of our physics department, made measurements with the grid which have guided us in our use of this method up to the present.

From February 1950 until Sept. 1, 1951, 149 patients with cancer proved by biopsy, and established as hopeless from the point of view of surgery or conventional radiotherapy, were treated by this method. Many of the group had been previously operated upon or had received conventional radiotherapy, without improvement. Most of the patients had metastatic foci, and cure was not contemplated. Relief from pain, hemorrhage, and other symptoms was the primary object of the treatment.

[1] From the Tumor Clinic and Radiotherapy Department, Mt. Sinai Hospital, New York. Presented at the Thirty-Sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950. Statistical material rewritten, brought up to Sept. 1, 1951.

TECHNIC AND PHYSICAL FACTORS

The physical factors which were employed are indicated in Table I. The majority of the patients were treated with 200 kv. More recently, a small number have been treated at 400 kv. The circular grid openings were either 0.5, 1.0, or 1.5 cm. in diameter, and the open areas always equalled 40 per cent of the total portal area. The grid is made of 4 mm. of lead rubber for 200 kv., which allows a transmission of 3 per cent of the radiation applied to the surface through the closed areas. The same openings are used throughout the treatment, the grid pattern being outlined on the skin with carbol fuchsin or some other dye. Meticulous care is exercised in applying the grid to the same area at each treatment. Openings of 0.5 cm. were found not to be practical. Holes larger than 1.5 cm. were also impractical, especially in small irregular areas. For flat surfaces, openings of 1 cm. can be used. On irregular surfaces such as the axillae or inguinal regions, openings of 1.5 cm. have seemed to be the most useful.

TABLE I: PHYSICAL FACTORS IN ROENTGEN THERAPY WITH A GRID

Kv.	h.v.l.	F.S.D.	Portal
200	0.9 mm. Cu	50	50–400 cm.²
400	4.1 mm. Cu	70	50–225 cm.²

Open area of grid equals 40% of portal area.
Grid openings 1–1.5 cm. in diameter.
Daily dose 600–1,200 r/air.
Over-all treatment time 28–45 days.
Total dose 12,000–24,000 r/air per portal.

The question of inhomogeneity has evoked considerable speculation regarding the merits of this method. Some brief observations may be in order on this question. There is some doubt whether absolute homogeneity is necessary in a tumor for its eradication. It is conceivable that a single short application with a grid might produce significant inhomogeneity in the depth. However, with an increase in depth, let us say at 10 cm., the hills and valleys in the isodose curves flatten out because of the relatively increased scatter. Also, with multiple application, movement of the patient, mobility of the skin, and slight changes in angulation make it impossible always to set up the portals so that the fields below the surface coincide exactly with the previous ones. The measurements of Loevinger, as will be shown in his report on this subject, indicate that the use of multiple applications smears out the inhomogeneity to a great extent at 10 cm. from the surface. For superficial tumors extending no more than 5 cm. below the surface of the body, physical measurements indicate excessive inhomogeneity (a high of 60 per cent and a low of 18 per cent of the surface dose, with a weighted average of 40 per cent). This is analogous, in a way, to a radium or radon implant. Naturally in such circumstances the total dose given is smaller (12,000 to 15,000 r). With a well applied grid it is possible that under these circumstances areas receiving the minimal dose will be undertreated on a purely physical basis. This question can be answered only by clinical trial in suitable patients.

REACTIONS

At the beginning of our study, following Marks' original demonstration, 16 patients were given 24,000 r to one portal (100 to 150 sq. cm.), with grid openings 1 cm. in diameter, in a 28-day over-all treatment period. The constitutional reactions from the grid treatment with fields up to 20 × 20 cm. (400 sq. cm.) at rates up to 1,200 r in air per day are no worse than those encountered when 250 r at 200 kv. is given to an open portal of similar size. Of over 130 patients, only one (with lung cancer) showed a transitory leukopenia lasting for several weeks.

Skin: Among the 16 patients treated with 24,000 r to one portal, healing of the skin occurred in 12 without incident within ninety days after the beginning of treatment. One patient previously treated with conventional x-ray irradiation, and retreated through the same area with a grid, failed to show healing after 150 days, when she died from intestinal

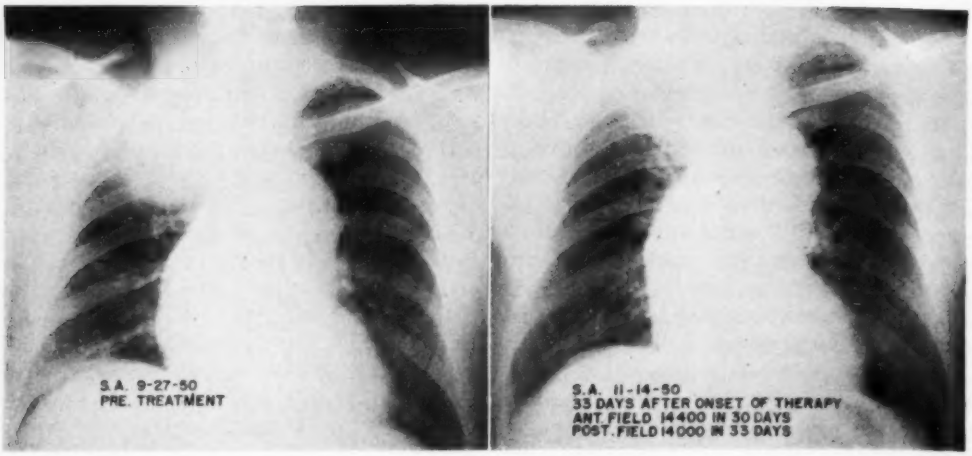
injuries. In another patient, with a breast cancer, healing had occurred six months after treatment. Now, seventeen months after grid therapy, moderate atrophy and telangiectasia are present. In a third patient with cancerous inguinal lymph nodes there was failure to heal after nine months, and death from hemorrhage ensued. Another patient still has a small unhealed ulcer in the suprapubic region fourteen months after treatment. Two patients with bladder cancers show marked atrophy of the skin after fifteen months.

When the treatment is given at the rate of 1,200 r a day, an erythema may occur on the second or third day. This becomes gradually more intense, yet discrete, and shows the grid pattern thereafter. If the treatment is continued for a twenty-eight-day period for a total dose of 24,000 r, blistering of the skin under the translucent areas will become confluent, with wet desquamation on about the thirty-fourth day. In spite of this, one can still see the grid pattern in the irradiated portal. In general, the anterior surfaces of the body heal ten days sooner than the posterior aspects following a dose of 24,000 r. In the majority of patients treated in this manner, healing will occur about ninety days after the beginning of treatment. However, if two opposing portals are used and 600 r in air are given daily to each portal for a total of 12,000 to 15,000 r per field in a twenty-eight- to forty-day period, the reaction is much milder and usually heals within three or four weeks after the appearance of the skin reaction. The epidermitis may be either moist or dry with the smaller dose and longer over-all treatment time. It has been noted that the skin in the inguinal folds and axillae, over the breast and inframammary fold, and over the internatal folds heals much more slowly and will seldom tolerate kindly doses up to 24,000 r. This is generally true of all areas where there is a great deal of moisture or subcutaneous fat and would be expected from our experience with conventional roentgen therapy.

Although Marks, in his original communication, advised the administration of the entire treatment through one portal, we treated most of the deep-seated lesions such as lung cancers and pelvic tumors through two opposing fields and occasionally with a third lateral field, with a total dosage of 15,000 to 18,000 r per portal and a prolongation of the over-all time from thirty-five to forty-five days. There can be no question that this approach, where possible and feasible, will improve the tolerance of the normal tissues. The healed skin is soft, slightly atrophic, and may still show a permanent grid pattern in the form of an array of atrophic circles outlined by pigmentation. A dose of 4,800 r through a grid over a twenty-eight-day period may leave a permanent grid pattern on the skin.

Bone and Cartilage: Although bone and cartilage, especially in the treatment of lung cancers, is very heavily irradiated, we have seen no damage to these structures. Our longest follow-up is twelve months in a patient who is still clinically free of disease (Fig. 1). Thoracotomies (3 patients) through such treated areas six to eight weeks after treatment showed no variations in healing from similar procedures in untreated patients. Two bladder cancers and one uterine cancer similarly treated with 24,000 r through one portal have thus far after fourteen months of follow-up shown no damage to the pubic or iliac bones. Another patient with an oral cancer who received 12,000 r to one portal has shown no ill effects to the mandible after a follow-up of fifteen months.

Intestines: Injury to the intestines may follow treatment with a grid to the upper abdomen with doses of 12,000 r to one portal. This is especially true in previously irradiated patients and those treated over laparotomy scars even without previous irradiation. In one of the latter group, with recurrent abdominal masses following resection of the colon, an intestinal fistula developed in the treated area. One patient receiving 22,000 r through one portal (15 × 20 cm.) in the suprapubic region



following hysterectomy has shown no evidence of intestinal damage after fifteen months. Another patient following an oophorectomy with diffuse pelvic deposits showed no intestinal damage fifteen months after receiving 9,000 r each to anterior and posterior pelvic fields for a dose in the mid pelvis of 5,000 r (weighted average) in a twenty-four-day over-all treatment time. Two patients with bladder cancer received 24,000 r to a single 10 × 10-cm. suprapubic portal and showed no evidence of bowel injury after a fifteen-month follow-up. Yet the inference is clear, as in experience with conventional radiotherapy, that in general the bowel is intolerant to doses approaching 6,000 r in four to six weeks. When a loop of intestine is adherent to a laparotomy incision or to a retained cervix after hysterectomy, the danger of injury is increased if the beam passes through such a fixed segment of bowel.

Mucous Membranes: The mucous membrane reactions in the mouth and in the vagina are similar to those encountered with conventional therapy. At the height of the reaction the grid pattern can occasionally be seen on the linings of these cavities.

Lungs: All patients with pulmonary and esophageal cancers showed x-ray evidence of pulmonary fibrosis of varying degrees. This may become evident as early as two months after the completion of treatment and may lead to severe cardiovascular embarrassment.

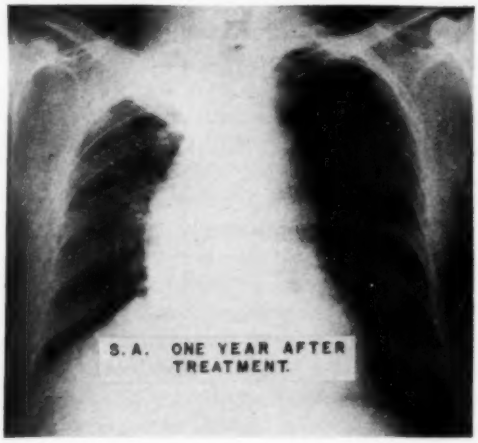


Fig. 1. Squamous-cell cancer of the right upper lobe in a 58-year-old patient, proved by aspiration biopsy. Patient symptom-free one year after treatment.

DESCRIPTION OF MATERIAL

Between February 1950 and September 1951, 149 patients with advanced cancers were treated with a grid. One hundred and twenty-seven of these were able to complete a course of treatment where either the primary tumor or the metastatic deposits received about 6,000 r ("weighted average," Loevinger). The anatomical sites treated are shown in Table II. Many of these patients died several months after treatment, either from metastases already

TABLE II: TUMORS TREATED WITH X-RAYS THROUGH A GRID (FEBRUARY 1950 TO SEPTEMBER 1951)

Brain	12	Breast	4
Oral	6	Kidney	3
Pharynx	2	Bladder	23*
Esophagus	6	Uterus	8
Lung	35	Rectum	5
Lymph Node Metastases	11		
Miscellaneous	13		
Total Number	128		

* Nine patients treated with a combination of grid technic and a Foley bag containing radium.

present when the treatment was begun or from metastases which appeared shortly after completion of treatment. In the majority of the patients treated there was some clinical improvement, which varied in degree and in duration. In some, there was no recurrence of the primary tumor during the life of the patient, and in several there was clinical arrest of disease during a fifteen-month period of follow-up.

The series included 12 patients with brain tumors, 2 of which were metastatic, one from the breast and one from the kidney. The primary brain tumors included 6 glioblastomas, an oligodendroglioma, a spongioblastoma, a pinealoma, and a hemangioendothelioma which had been operated upon twice previously. All of the patients had craniotomies. The results of grid treatment in this group are too recent for assessment of its value.

Of 6 patients with oral cancer, one with far advanced disease involving the entire tongue, floor of the mouth, and lymph nodes has had palliation for one year. A second patient with a tongue cancer and extensive bilateral neck node involvement shows control of the primary lesion for over one year but persistence of disease in the neck. Another patient with a cancer of the floor of the mouth with extension to the skin of the lip is free of disease for a period of fifteen months. The fourth patient in this group with extensive cancer of the tongue and cervical lymph nodes showed microscopic evidence of disease in the tongue at autopsy. He had three other primary cancers, one in the esophagus and two in the colon, which caused his death one month after treatment, from inanition. One of the remaining two patients in this group is living twelve months after treatment with disease and the other was treated too recently for evaluation.

Two patients with pharyngeal cancer showed clinical regression of the disease locally, but both died within a few months, of distant metastases.

Of the 6 patients with cancer of the esophagus, 3 had moderate palliation, 1 for almost fifteen months and another for about a year.

Thirty-five patients with cancer of the lung were treated. These included postoperative cases in which the lung lesion was unresectable and/or hilar lymph nodes were involved. Others had supraclavicular node involvement and/or positive carina biopsies. Marked palliation was evidenced by disappearance of cough, hemoptysis, and pain in most instances. In one patient (Fig. 1) with a large aortic aneurysm and a lung cancer there was complete disappearance of the tumor on x-ray examination for a period of twelve months and the patient is at present clinically free of symptoms. In 3 patients with positive carina biopsies, post-treatment bronchoscopy revealed the carinas and bronchi to be free of disease. Two of these patients were subjected to thoracotomy several months after the grid treatment. Pneumonectomy was done and the bronchoscopic findings proved to be correct. Residual disease was found, however, beneath the bronchus in the pulmonary tissue in both cases. One of these patients died six months later from distant metastases. The second patient was free of disease for eleven months after pneumonectomy, when cranial metastases developed. The third patient with a positive carina biopsy shows no bronchoscopic evidence of disease but the interval following treatment is too brief for appraisal of the result. Another patient (Fig. 2) with a positive bronchus biopsy had a pneumonectomy after grid therapy. There was no histologic evidence of disease in the excised specimen. This patient died with liver metastasis (autopsy) several months after surgery.

Three patients with cancer of the kidney

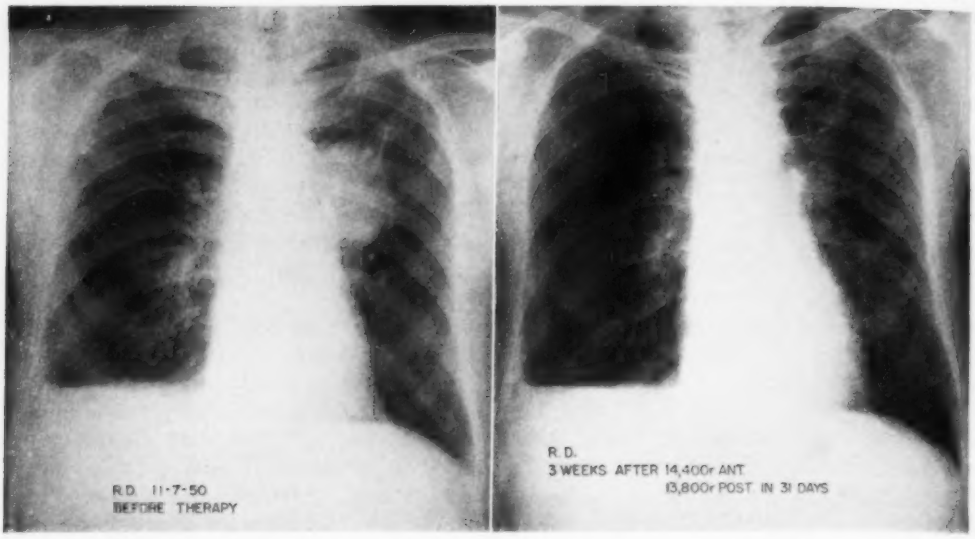


Fig. 2. Small-cell cancer of the left upper lobe in a 66-year-old patient, proved by bronchoscopy. Left pneumonectomy three months after grid therapy revealed no evidence of tumor. Death occurred two months after operation, from cardiac insufficiency. At autopsy the chest was free from tumor and only a solitary liver metastasis was found.

were treated following nephrectomy. Two of these showed invasion of the perirenal fat by squamous-cell carcinoma. One of the group has remained well and free of disease for twelve months after treatment. The other two died of distant metastases.

Twenty-three patients with cancer of the bladder were treated, in 14 instances with the grid only and in 9 more recent cases with a combination of grid therapy and a Foley bag containing radium. In these patients the disease was so far advanced that the only alternative form of treatment was total cystectomy with lymph node dissection or pelvic evisceration. Most of these patients were advanced in years and their general condition did not allow of radical surgical procedures. Many of them showed extravesical masses and impaired kidney function and many had previously been treated with multiple transurethral resections and with radon seed implants. The bladder reactions in the patients who had previously been treated with radon seeds were extremely severe and protracted. Two patients remained free of local disease for fifteen months after treatment. Eight died within one to fifteen months after treatment, 1 from uremia and 7 from generalized metastases. The remaining 15 patients are living after brief intervals.

There were 8 cancers of the uterus, 3 originating in the cervix and 5 in the fundus. All had been previously treated with radium or x-rays or by hysterectomy, without success. One of these patients showed good palliative response to the grid therapy. Edema of lower extremities and ascites disappeared for a period of six months.

Four of the 5 cancers of the rectum were postoperative and some palliation was achieved in these cases for short lengths of time. One patient with a primary inoperable rectal cancer remained free of local disease for one year and died at the end of that time with skeletal metastases.

Ten of the 11 patients with metastatic lymph nodes showed good local response but, as would be expected, lived only a short time after treatment because of widespread dissemination of disease.

The group of miscellaneous tumors included 3 metastases following resections of the large bowel, a malignant tumor of the humerus of undetermined type, a recurrent

tumor in a nephrectomy wound, a sacroneural epithelioma, 2 ovarian carcinomas, a cancer of the prostate and bladder with an extravesical mass, an embryonal tumor of the stomach metastatic from the nasopharynx, a fibrosarcoma of the lower extremity with retroperitoneal metastases, one plasmocytoma of the antrum, and one desmoid (benign fibrosarcoma).

This last patient was treated in September 1950 after two surgical procedures for the removal of the pelvic desmoid and conventional radiotherapy. At the second operation it was found that the tumor had extended around the iliac vessels and shortly afterward a mass was found impinging upon the rectosigmoid. The patient was advised to have a hemipelvectomy, which she refused. Though she was told that it was highly unlikely that this type of tumor would respond to any form of radiotherapy, she and her family decided to try this method as a last resort. One year following treatment the mass impinging upon the rectosigmoid was no longer palpable. The edema of the lower extremity has subsided considerably and the patient is free from pain.

COMMENT

Treatment of advanced cancer brings up many difficult problems for the physician who assumes responsibility for the care of these patients. He is usually confronted with individuals who have no hope, who are emaciated, anemic, and pain ridden. To close his eyes and disregard these patients would be a dereliction of his duty as a physician. In sponsoring any new type of treatment, especially a heroic one such as grid therapy, there is always the probability of aggravating an already desperate condition, as well as the possibility of taxing the resources of the patient to such a degree that his last days are made more miserable than if no active treatment had been given. To make a decision in such instances requires long clinical experience, patience, and an awareness of the complications and damage that may be done.

It is simple to assess the survival time and five-year cure rates in patients with early cancers, but extremely difficult to measure and record palliation except by clinical experience, which may at times be nebulous and colored by wishful thinking. These are the difficulties that confront one when there is a departure from conventional forms of treatment and a new method is proposed. Our material has been demonstrated to radiotherapists from various parts of this country and abroad. It is the general consensus of opinion that this method or a modification of it may contribute real benefit to the hopeless patient with advanced cancer. Naturally, our experience is brief from the point of view of time and the numbers are too few to reach any real conclusions about the merit of the grid technic. It is possible that greater usefulness may be found in a combination with conventional or other forms of radiation therapy.

In applying this method, the strictest criteria should be followed in the determination of an accurate diagnosis by biopsy and the establishment of incurability by consultants in various branches of medicine who have had long experience in oncology. Our experience in the treatment of cancer of the lung and cancer of the bladder is such as to encourage us to pursue this method further, particularly in these two anatomical sites. A more detailed report on this material will be presented soon.

We now consider a dose of 24,000 r given to one portal in a twenty-eight-day period to be *excessive*. Experience leads us to believe that 18,000 r to one portal should not be exceeded and that this should be protracted over a period of thirty-five to forty-five days. Even this dose may prove to be too high as our experience broadens. From a technical point of view, the grid method is easier to apply and in some cases less taxing to the patient than rotation or multiple field therapy at 200 kv.

SUMMARY

A preliminary report is presented on the use of roentgen therapy with a grid and high dosage in patients with advanced,

hopeless cancers. Physical measurements indicate that there is an advantage in depth dose with the grid over the conventional open portal method. This is predicated on the assumption that normal tissues can tolerate the larger doses mentioned in this report. One hundred and twenty-seven patients have completed treatment during a fifteen-month period. The primary aim of palliation and prolongation of useful life seems to have been achieved in a number of these patients. Further experience and studies regarding dosage (over-all time, fractionation, quality of radiation) and normal tissue tolerance may indicate that this is a valuable method in obtaining palliation and occasionally cure in patients with advanced cancer. The doses expressed in this report should be employed only in hopeless proved cancers. The most promising results were obtained in cancer of the lung and urinary bladder.

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SUMARIO

Recientes Observaciones Clínicas con la Rejilla en la Roentgenoterapia del Cáncer Avanzado: Comunicación Preliminar

Esta comunicación preliminar versa sobre el empleo de la roentgenoterapia con una rejilla y alta dosis en los enfermos desahuciados con cánceres avanzados. Las mediciones físicas indican la superioridad de la dosis profunda con la rejilla sobre la técnica habitual de puertas abiertas. Esto se basa en la suposición de que los tejidos normales pueden tolerar las dosis mayores mencionadas en este trabajo. Ciento veintisiete pacientes han completado el tratamiento durante un período de quince meses. En varios de ellos parece haberse alcanzado el fin primordial de la paliación y la prolongación de la vida útil. Ulteriores observaciones y estudios relativos a la dosificación (tiempo total, fraccionación, calidad de la radiación) y la tolerancia de los tejidos normales acaso indiquen que este método es valioso para obtener paliación y a veces curación en los cancerosos avanzados. Las dosis consignadas en esta comunicación sólo deben emplearse en cánceres comprobados con la biopsia y definitivamente desahuciados desde el punto de vista de la cirugía o la radioterapia convencional. Parece que no debe excederse de una dosis de 18,000 r por puerta, esparciéndola a través de un período de 35 a 45 días. Los resultados más halagüeños fueron obtenidos en el cáncer del pulmón y de la vejiga urinaria.

Depth Dose Curves for Grids in X-Ray Therapy[1]

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THE USE OF treatment grids (*i.e.*, radiopaque material with alternate open and closed areas) in x-ray therapy requires depth dose information not given in the conventional depth dose tables. It is the purpose of this paper to show that the essential information can be derived from these tables. A detailed analysis of the grid depth doses will be presented which tends to corroborate the general clinical impression that the function of the grid is to preserve areas of the skin, which will serve as centers of regrowth, while still delivering adequate and sufficiently homogeneous radiation at a depth.

The use of deep therapy treatment grids and an understanding of their effect on the distribution of radiation are not new. As early as 1909 Köhler (1) proposed the use of a grid as a method of delivering a deep tumor dose while protecting against radiodermatitis. In 1925 Abeles (2) discussed the distribution of radiation for a grid from a geometrical point of view (without, however, considering the effect of scattered radiation).

In 1933 Liberson (1, 3), who was not aware of the previous work, published depth dose measurements and animal and clinical studies with "multiperforated screens" essentially the same as those being reported here. His back-scatter and depth dose measurements were made with ionization chambers sufficiently large so that they averaged over both the maxima and minima in radiation dose-rate. His measurements verified his expectation that the ratio between the average dose-rate with and without the grid equals the ratio of the open area of the grid portal to the total area. He concluded that, "since the remote effect upon the skin of both rabbits and man is the same when three or four times as much radiation is delivered through the perforator as without it, the underlying tissue actually receives one and a half to two times as much radiation with the perforator as without it." This statement summarizes essentially our present view on the depth dose effect of the treatment grid. Similar reports followed in 1934, by Haring (4) and Woenckhaus (5).

In 1945, Grynkraut (6) described biological and clinical experiments with a lead grill having 3 × 3-cm. openings separated by 5 mm. of lead. He made photographic tests of the dose distribution and showed that the sharp picture of the grill obtained on a film at a distance of 10 cm. in air was greatly blurred when water was placed between the grill and the cassette. He concluded that the grill "prevents the vasomotor phenomena of erythema" by protecting areas of the skin, while still giving a more or less homogeneous dose at a depth. He advised that the x-ray air dose must be doubled when using the grill.

In 1949, Jolles (7) reported the clinical use of an "alternating chessboard" type of treatment grid. Part of the treatment was given through a certain grid, and the remainder through a complementary grid. The purpose was to decrease the total treatment by allowing repair of essential structures.

A preliminary report has already been given (8) on the measurements and calculations to be discussed here. These are limited to x-rays with a half-value layer of 1 mm. Cu at 50 cm. focal-skin distance. The depth dose in tissue during treatment with such x-rays may be considered to be

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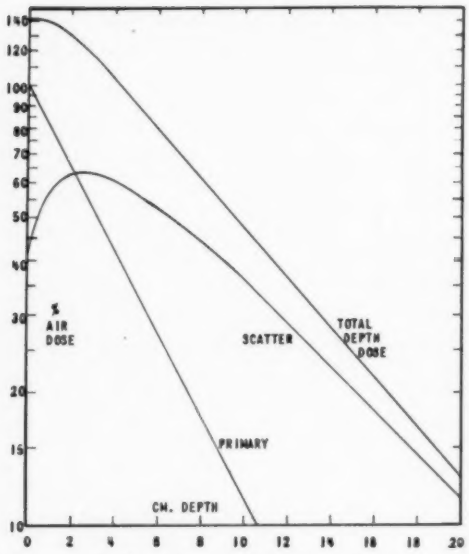


Fig. 1. - Analysis of open field depth dose into primary and scatter components (10 × 15 cm. portal, 50 cm. F.S.D., 1 mm. Cu h.v.l.).

made up of two parts, that due to the primary beam and that due to scattered radiation. Figure 1 shows the method of making this analysis for a conventional 10 × 15-cm. field, on the axis. The top curve is the usual depth dose, taken from Quimby's published data (9). The bottom curve shows the depth dose due to the primary beam alone. This represents the depth dose from a very narrow beam—a so-called pencil beam—and was determined in our laboratory by making depth dose measurements for a number of small fields, and then extrapolating to get the depth dose for a pencil beam (10). The primary beam is attenuated exponentially, being reduced to 50 per cent of its initial intensity by 32 mm. of water. Essentially the same primary depth doses are given in the tables of Mayneord and Lamerton (11), under the heading "zero field size."

Since the top curve in Figure 1 represents the total depth dose, and the bottom curve represents the primary dose, the difference must represent the dose due to scattered radiation. That difference is also plotted in the figure. It will be noted that the primary and scattered contributions are equal at about 2 cm. depth, but that deeper than 2 cm. most of the dose is due to scattered radiation.

Consider now the effect of a grid which is 40 per cent open and 60 per cent closed, with the holes distributed uniformly over the treatment area. A radiograph of such a grid, taken at 15 cm. in air, is shown in Figure 2. The grid consists of a rectangular array of holes, 1 cm. in diameter, spaced 1.4 cm. apart, in lead-rubber which transmits 3 per cent of the primary beam. The total amount of radiation entering the treatment volume is $40 + (0.03 \times 60) = 42$ per cent of that which enters the volume without the grid in place. Hence the *average* dose to the treatment volume at any depth must be 42 per cent of the open field dose to that depth.

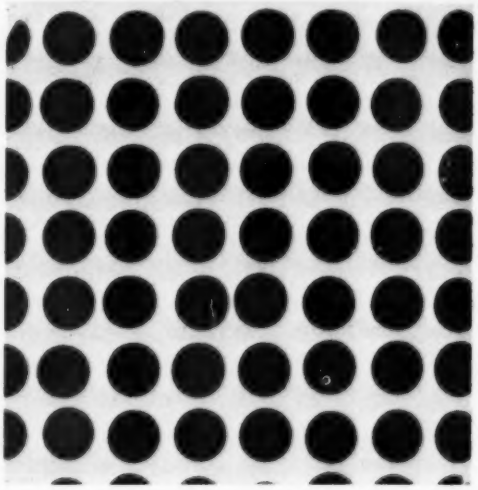


Fig. 2. Radiograph of grid, with openings 1 cm. in diameter, 1.4 cm. between centers. Open area 40 per cent.

The scattered radiation reaching the central axis under such a grid must be 42 per cent of that for the full field. Thus the depth dose under one of the holes near the axis must be the primary plus 42 per cent of the full field scatter. In between the holes near the axis the dose must be just 42 per cent of the full field scatter plus 3 per cent of the primary intensity at the depth in question. This analysis is shown in

Figure 3. The dotted line represents the primary dose. The curve marked "minimum" is 42 per cent of the full field scatter. The curve marked "maximum" is the sum of these. The curve marked "weighted average" is an average of the maximum and minimum curves, computed by taking into account the fact that the grid is 40 per cent open and 60 per cent closed. This average can also be computed by simply taking 42 per cent of the full field depth dose. These

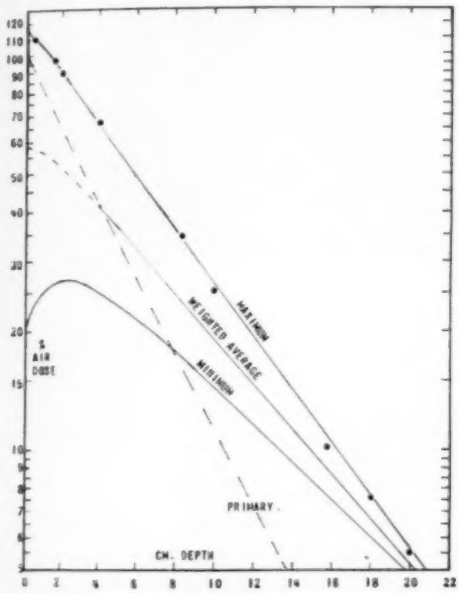


Fig. 3. Analysis of depth dose with 40 per cent open grid (10 × 15 cm. portal, 50 cm. F.S.D., 1 mm. Cu h.v.l.).

computations apply near the central axis. The maximum dose will occur under a hole, the minimum dose between holes.

The back-scatter used in computing the curves of Figure 3 is just 42 per cent of the back-scatter tabulated for that particular open field. Depth dose measurements made in our laboratory are multiplied by this back-scatter value to give the experimental points shown in the figure. The close agreement between these points and the maximum curve shows the general correctness of the analysis.

The same analysis has been made for portals of other sizes, and the maximum

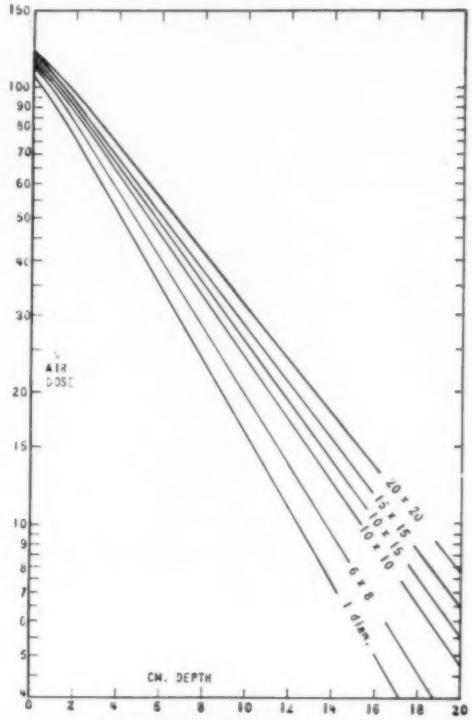


Fig. 4. Maximum grid doses (40 per cent open grid) near center of field, for various portals (50 cm. F.S.D., 1 mm. Cu h.v.l.). Portal dimensions in cm.

depth doses for these fields are presented in Figure 4. These curves have also been closely checked by experimental measurements. Figure 5 presents the ratio of the maximum to the minimum dose for the same portals. The average dose at any depth is easily computed, when needed, by simply taking 42 per cent of the conventional open field depth dose. Figure 5 illustrates graphically the considerable inhomogeneity at the skin and the rapid approach to homogeneity at a depth.

The experimental points were measured with the apparatus illustrated in Figures 6 and 7. Measurements were made in a water phantom large enough to give saturated scatter in all directions. The ionization chamber had an active volume 4 mm. in diameter and 9 mm. long. It was moved inside the water tank by a motor-driven apparatus controlled from the x-ray control stand. Selsyn motors indicate the position

of the ionization chamber to an accuracy of about 0.1 mm. It was necessary to align the apparatus rather precisely. If the ionization chamber was as much as 1 mm. off the axis of the hole, the readings were slightly in error. This accurate alignment was accomplished by means of fluorescent screens, with the tank only partly filled with water.

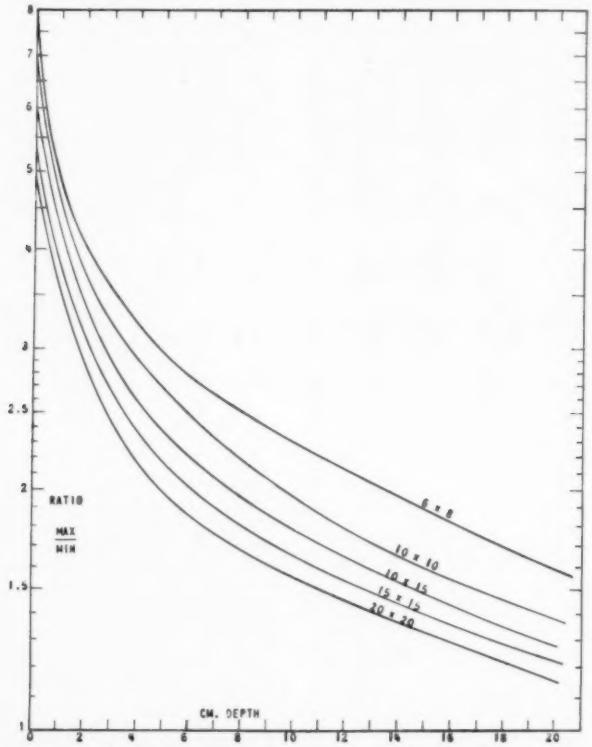
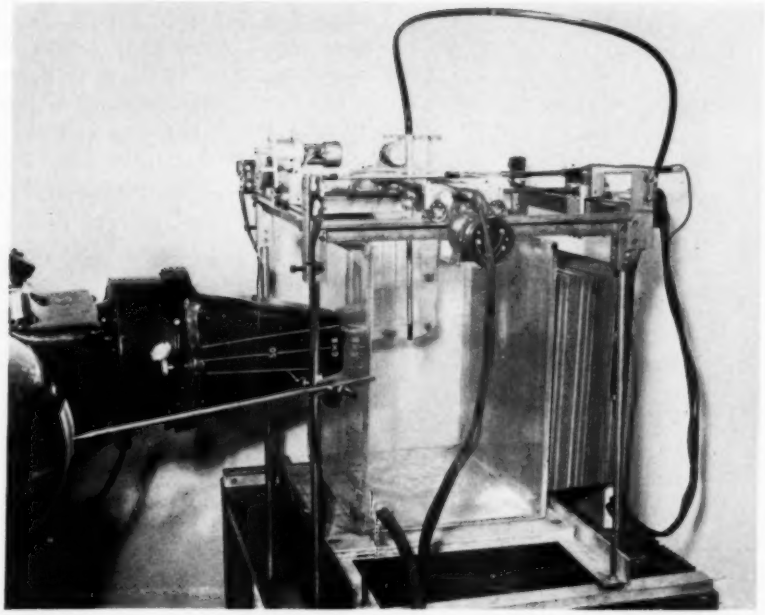
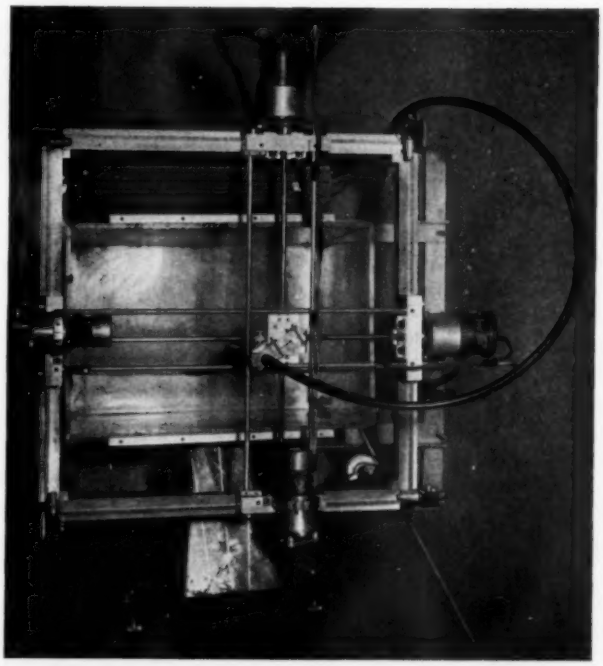


Fig. 5. Ratio of maximum to minimum grid dose (40 per cent open grid) with increasing depth, for various portals (50 cm. F.S.D. 1 mm. Cu h.v.l.). Portal dimensions in cm.

The difficulty of alignment in making depth dose measurements is paralleled by a certain difficulty of realignment in treating patients. Figure 8 shows the grid pattern on a film at the exit portal of a patient, with four independent set-ups of the treatment cone. The four separate projections of the grid holes are easily visible. (The contrast between the projection of the holes and the intervening spaces has been greatly increased photographically in this picture and the next, for purposes of illustration.) Figure 9 shows a similar film, at the exit portal of a patient, with twelve independent set-ups of the cone for a posterior treatment to the midline of the chest. The shadow of the sternum and the spine is responsible for the lighter densities along the center line of the picture. During these twelve 5-second exposures, the patient was immobilized on the treatment couch, remaining fixed with respect to the film and the grid. The doctor raised the machine and moved it in all degrees of freedom before replacing it in the treatment position for each exposure. Note that the smearing is greater in the longitudinal direction than in the transverse. The grid pattern is, however, still visible after twelve set-ups.

It seems safe to assume that, over a period of twenty-eight days, the realignment will be less accurate than that shown in





Figs. 6 and 7. Side and top views of remote positioning apparatus for making water phantom measurements.

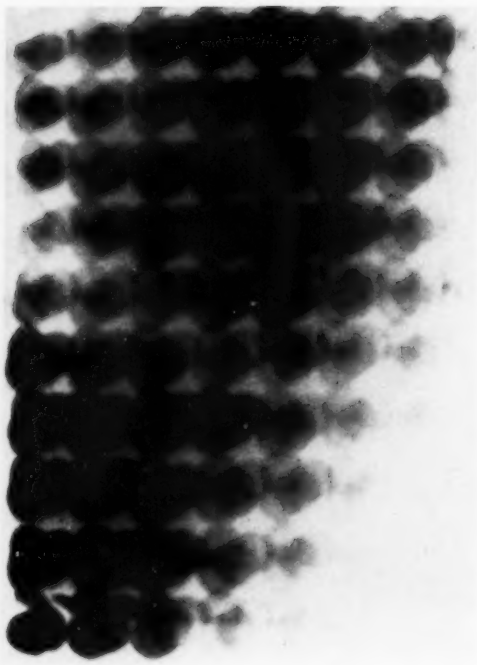


Fig. 8. Radiograph of grid field on the chest. Four independent set-ups of the treatment cone.

Figure 9. Even though the grid is reapplied to exactly the same skin area for each treatment, it does not seem likely that the patient, the grid, and the x-ray machine can be reassembled on successive days so accurately that the grid pattern will persist in the tissue at any great depth.

A statement of the depth dose distribution under the grid, as given here, cannot of itself explain the seeming advantage of grid therapy. The picture must be completed with some medical information. It is known that with a 10 × 15-cm. open portal the skin will tolerate a dose of about 4,600 r (3,300 r in air), fractionated over twenty-eight days, for the quality of radiation being considered here (12). It has been found in clinical studies (13) that the skin will under some circumstances tolerate as much as 24,000 r in air when given through a 40 per cent open grid and fractionated over twenty-eight days, though this is in general considered excessive. The depth doses for these two methods of treatment are shown in Figure 10. It is seen there that the minimum grid skin dose is about the same as the open field skin dose, while the average 10 cm. grid depth dose is about equal to the open field skin dose, and about three times the open field 10 cm. depth dose. Thus the increased skin tolerance when using the grid allows an increase in air dose which more than compensates for the decrease in radiation caused by the opaque sections of the grid.

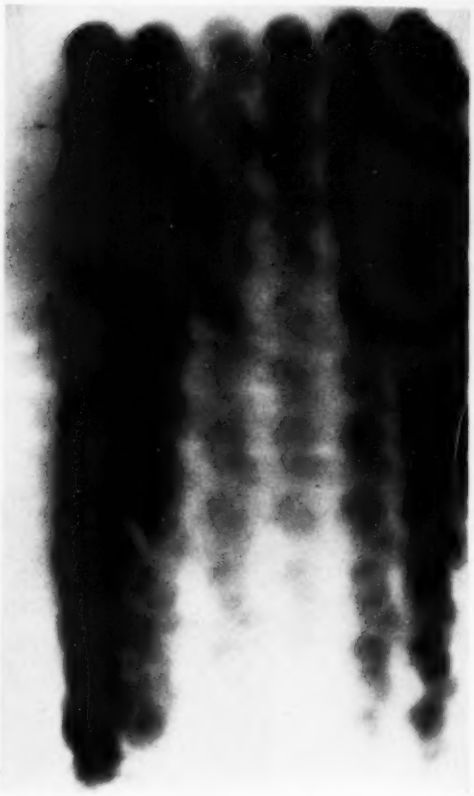


Fig. 9. Radiograph of grid field on the chest. Twelve independent set-ups of the treatment cone.

The present discussion has used numbers based on a radiation quality of interest to our radiotherapy staff. For the sake of definiteness, the detailed illustration has been in terms of a 10 × 15-cm. portal at 50 cm. F.S.D. More generally, grid depth doses can be said to depend on focal-skin

distance, half-value layer, portal area, and percentage of open area. They will *not* depend on size or shape of the grid holes, provided only that the holes are considerably smaller than the treatment portal, and uniformly distributed over it.

The analysis presented here depends upon knowledge of the primary dose, a quantity not given in the depth dose tables most commonly used in this country. Fortunately, the information of most interest to radiologists who may contemplate using the grid for therapy can easily be computed from the standard depth dose tables. If the fraction of open area of the grid and the per cent transmission of the grid material are known, then skin maxima and minima and average depth doses are easily computed. It seems reasonable to assume that, on the skin, the maximum and minimum doses are biologically significant, while the average dose is not. (For this reason the curves giving the average grid dose in Figures 3 and 10 are shown as dotted lines for the first few cm.) At a depth, the average dose becomes biologically significant, and the maxima and minima are probably not, due to the smearing out of the maxima discussed above. Then the computation is made with the help of the following formulas:

Let

p = fraction of grid area which is open
$(1-p)$ = fraction of grid area which is closed
q = fraction of primary beam transmitted by grid material
$s = p + q(1-p)$ = fraction of the total primary radiation which gets through the grid, both open and closed areas being considered
D_z = open portal depth dose in r/100 r in air, at depth z
D_0 = open portal skin dose in r/100 r in air

Then the minimum skin dose is given by

$$s(D_0 - 100) + 100\,q$$

The maximum skin dose is given by

$$s(D_0 - 100) + 100$$

The average dose at any depth is given by

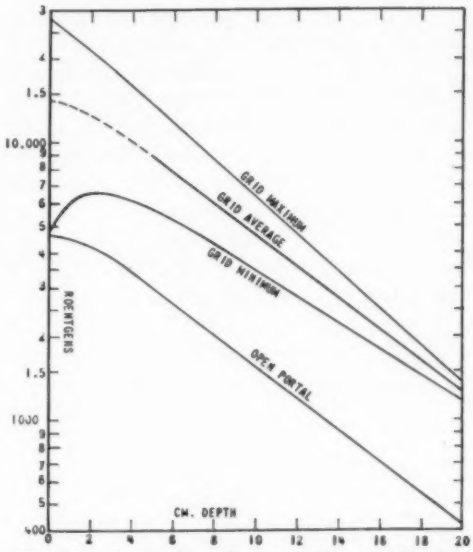


Fig. 10. Comparison of open field and grid depth doses during fractionated course of therapy (10 × 15 cm. portal, 50 cm. F.S.D., 1 mm. Cu h.v.l., treatment given in 28 days to each field.) Open field: 3,300 r in air. Forty per cent open grid: 24,000 r in air.

sD_z. As an example of the use of these formulas, consider a grid which is 40 per cent open and which transmits 3 per cent of the primary beam. Then $p = 0.40$; $(1 - p) = 0.60$; $q = 0.03$; $s = 0.40 + 0.03 \times 0.60 = 0.42$. Then for a 10 × 10-cm. portal, 50 cm. F.S.D., 1 mm. Cu h.v.l., Quimby (9) gives the following depth doses:

Depth →	0	5	10	15 cm.
D_z →	136	82	41	24 r/100 r in air

So now the minimum skin dose is $0.42 \times 36 + 100 \times 0.03 = 18$ r/100 r in air. The maximum grid skin dose is then 115, and the ratio of the maximum to the minimum dose on the skin is $115/18 = 6.4$. The average dose at any depth is just 42 per cent of the open field depth dose:

Depth →	5	10	15 cm.
Grid depth dose →	35	17	10 r/100 r in air

SUMMARY

A method is presented for analyzing therapy depth doses into a primary and scattered fraction. It is shown that this makes it possible to compute the maximum

and minimum depth doses which will occur with the use of the treatment grid. The ratio of maximum to minimum is large at the surface (5 to 7) but drops rapidly at a depth, due to scattered radiation. Evidently the grid produces a considerable inhomogeneity at the skin, but much less inhomogeneity at a depth.

The essential information about grid depth doses can be computed from the standard depth dose tables.

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ADDENDUM

Since the above was written, Wheatley and Worthley (1) have reported calculations and Jacobson and Lipman (2) have reported measurements which confirm the analysis presented above. Further measurements by us have likewise been fully consistent with this analysis. These measurements were made on both maximum and minimum depth doses at 200 and 400 kv.p. near the central axis, for portal areas from 50 to 400 sq. cm. and depths up to 20 cm. It may be concluded that for the cases tested the scattered radiation reaching the neighborhood of the central axis traveled a sufficient distance laterally to make valid the assumptions of the calculation. The basic assumption used was that the fraction of scattered radiation with the grid in place is just the fraction of the primary radiation that gets through the grid. But if this assumption is true on the central axis, it must likewise be true off the central axis, since the scattered radiation will travel the same distance in reaching an off-axis point as in reaching an axial point. As a result, "the distribution of the scatter is unmodified by the presence of the grid, so that the ratio between the scatter at any point and the central axis scatter is the same whether or not the grid is in position. The scatter varies smoothly across the field with no discontinuity at the edge of a hole" (1). These conclusions must apply at all kilovoltages above 200 if they apply at that value, since scattered radiation must get harder with increasing kilovoltage.

Measurements of the maxima and minima in grid depth doses are difficult to make with accuracy. Probably the most satisfactory method of getting detailed information on grid depth doses for a particular therapy unit is to make open portal measurements of depth doses, and a determination of the primary depth dose. Then the grid depth doses can be calculated with better accuracy than if they had been measured. If off-axis values are desired, the open portal measurements must also be made off the axis, and used to determine the scattered radiation off the axis. Wheatley and Worthley state that they are preparing tables of scattered radiation which may be used for this purpose.

Recent clinical experience (3, 4) has confirmed the value of the grid in certain cases. But it should be noted that the extraordinarily high doses used in the clinical work quoted previously are not necessarily part of grid therapy. The grid might conceivably be of use in any situation where radiation therapy is given to large fields and skin tolerance is a limiting factor. The air dose need not necessarily be increased beyond the amount necessary to compensate for the radiation absorbed in the grid material. The inherent inefficiency and increased treatment times which result from absorbing a large fraction of the primary radiation in the grid material will probably always serve to make the grid unpopular with therapists when more efficient methods of treatment are available.

Jan. 9, 1952

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SUMARIO

Curvas de Dosis Profundas para Rejillas en Roentgenoterapia

Preséntase un método para analizar las dosis de terapéutica profunda en fracciones primaria y esparcida. Demuéstrase que esto permite computar las dosis profundas máxima y mínima que se obtendrán con el tratamiento a través de una rejilla (véanse los dos trabajos anteriores). La proporción de máxima a mínima es grande (5 a 7) en la superficie, pero baja rápidamente a cierta profundidad, debido al esparcimiento de los rayos. Evidentemente, la rejilla produce considerable inhomogeneidad en la piel, pero mucha menos a cierta profundidad.

La información esencial acerca de dosis profundas con la rejilla puede computarse por medio de las tablas corrientes de dosis profunda.

DISCUSSION

(Papers by Marks; Harris; Loevinger)

Wm. L. Palazzo, M.D. (Teaneck, N. J.): Dr. Marks is to be commended for his courage in using large doses of irradiation. Much of the modern concept of delivering large doses through a grid is based upon Anna Goldfeder's experimental work on animals in which she found that 24,000 r and more through small portals was followed by uncomplicated skin healing. Dr. Marks' paper constitutes a general introduction to the clinical use of the grid but does not deal in detail with the total doses nor with specific reactions, which are covered to a better extent by Dr. Harris.

Those of us who are using the grid and those who contemplate using it would like to have answers to several questions

(1) What are the total doses of radiation, in relation to time of delivery, that are tolerated?

(2) How many of Dr. Marks' 100 cases showed a failure of skin healing following therapy?

(3) In how many was there a breakdown after initial healing and what was the time interval?

(4) Is it implied that all of the 64 patients who completed therapy obtained at least 50 per cent palliation?

Dr. Harris points out that 75 per cent of all patients with cancer are considered incurable. This represents a large group who may be offered some form of palliative therapy providing this attempt at palliation is not a worse ordeal than suffering from cancer itself. He wisely points out that the decision to attempt palliation is often a difficult one to make.

I agree with him that if a decision is made to use grid therapy, there is no reason why multiple fields should not be employed. Dr. Harris supplies the answer to one of the questions aimed at Dr. Marks, *i.e.*, 9 of 12 patients receiving 24,000 r to one portal showed skin healing within eighty-three days. Healing was observed in all patients receiving 15,000 r through one or two opposing portals. These results are indeed remarkable and are pointed out especially to those conservative radiologists who hesitate to give more than 3,000 r to a single portal.

In the use of a new roentgen technic, the physical considerations necessarily become of prime importance. Dr. Loevinger's theoretical calculations of the depth dosages beneath the grid appear to be well borne out by his measurements. It is noted that he used an ionization chamber 4.0 × 9.0 mm. in size.

At Bellevue Hospital in New York, Dr. Oscar Cohen and I, with the encouragement of Doctors Kaplan, Rubenfeld, and Goldfeder, have made some measurements using checkerboard grids of 1 and 2-cm. openings with 50 per cent and 26 per cent transmission area. Early in our work we abandoned the use of the conventional ionization chamber on the advice of Dr. Carl Braestrup. The main reason for this was the extreme technical difficulty of accurately placing the chamber beneath the center of small fields in the depths of the phantom. Accordingly we employed controlled densitometric readings.

Of the three grids employed, we found that the one delivering the most effective depth dose was the 1-cm. grid with 50 per cent transmission. For instance, at a depth of 10 cm., the measured depth dose, instead of being 50 per cent of the dose expected under a conventional 10 × 15-cm. open portal was 75 per cent and 64 per cent respectively under the open and closed portions of the grid. Another important phenomenon is that in the depth, the doses under the open and closed portions of the grid tend to approach one another; therefore, the beam tends to become more homogeneous.

These observations would suggest that therapy through a grid of this type may offer certain advantages over conventional therapy not only for palliation in advanced cases, as suggested by Dr. Marks and Dr. Harris, but also in the treatment of a wider range of tumors in which the cure rate may be improved.

Certainly many more measurements must be made with different types of grids to determine those that are more efficient and those where skin and tissue recovery will be greatest in relation to the effect upon a tumor in the depth.

Question: What is the rate of survival with this method?

Question: What is the material of which that last grid was made?

Dr. Marks (*closing*): To reply to the question about the rate of survival, our rating is by the degree of palliation obtained, namely, 100 per cent, 75 per cent, and 50 per cent palliation. Among 64 patients treated with this method, 100 per cent palliation was obtained in 14 with very advanced disease. One patient with a soft-tissue sarcoma of the upper thigh region was bedridden but now has been discharged home and is able to walk around. Another patient, with an intrasellar neoplasm, who had intractable pain in the occipital and parietal regions, with visual disturbances, showed marked improvement with subsidence of pain and partial recovery of vision. Of 3 patients with radioresistant Hodgkin's disease, 2 became ambulatory and are able to come to the Clinic for follow-up. Still another with a very advanced carcinoma of the urinary bladder with metastases to the skeleton, on whom seven operations were performed in the course of two years, is now ambulatory.

The grid is made of lead rubber 4 mm. in thickness, the rubber being 10 per cent by volume.

It cannot be too strongly stressed that it is imperative that the grid be placed in the same position at each treatment in order to obtain rapid healing, which is initiated in and extends from the covered areas of the skin.

Dr. Harris (*closing*): I believe there are two very important things to which I should call your attention. I don't think that any patient should be treated by this method unless a definite diagnosis of cancer has been made, and, for medicolegal reasons, I don't think any patient should be treated by this method without a consultation with a man in another field, as, for instance, a surgeon or internist, who should agree that the case is absolutely hopeless. We don't know what the normal tissues will do as time goes on. There is very considerable atrophy of the skin and, although our experience is too short to evaluate what may happen to bone, to cartilage, or to intestine, even in patients not previously treated, I warn all of you, if you are to embark on this treatment, to take every precaution to see that the correct diagnosis is definitely established and that the patients are really considered hopeless.

Comparison of Dose Distributions in Patients Treated with X-Ray Beams of Widely Different Energies[1]

HUGH GARRISON, M.D., JOHN ANDERSON, M.D.,
JOHN S. LAUGHLIN, Ph.D., and ROGER A. HARVEY, M.D.

ALL OF THE WORK published to date on supervoltage roentgen therapy indicates a lack of specific cancericidal advantage in relation to wave length of the radiation. The chief advantage of supervoltage therapy is an increase in quantity of radiation delivered to a deeply situated tumor. Normal tissues unavoidably irradiated have shown some rather slight arbitrary differences in tolerance to higher-energy radiations. These differences may well be related to difficulties in physical dosage measurements of absorption of qualities so closely related as those produced at 200,000 volts, 400,000 volts, and 1,000,000 volts.

The 23,000,000-volt betatron has given us an opportunity to evaluate differences in dosage effects over a much greater range of voltage than hitherto available. The purpose of this presentation is to compare the dosage distribution of x-rays from a 400,000-volt x-ray machine with those from a 23,000,000-volt betatron.

There are a minimum of five differences in the absorption of the radiations from these two sources which should be emphasized at the start. These are as follows:

1. The maximum dose for 400-kv. x-rays with a half-value layer of 2.75 mm. Cu is approximately at the surface, while with the betatron it is slightly over 4 cm. within the body (1, 4).

2. The relative dose for 400-kv. x-rays is 37 per cent at 10 cm. and 10 per cent at 20 cm.; with the betatron it is 81 per cent at 10 cm. and 54 per cent at 20 cm., both with 10-cm. ports (1, 4).

3. Side scatter is important for 400-kv.p. x-rays, but for the betatron x-rays scatter is predominantly forward (1, 4).

4. The entrance skin dose is at the peak with 400-kv. x-rays and at approximately 35 per cent of the peak dose with the betatron. The exit skin dose is usually negligible with 400-kv. x-rays, while with the betatron it may be higher than the entrance skin dose (1).

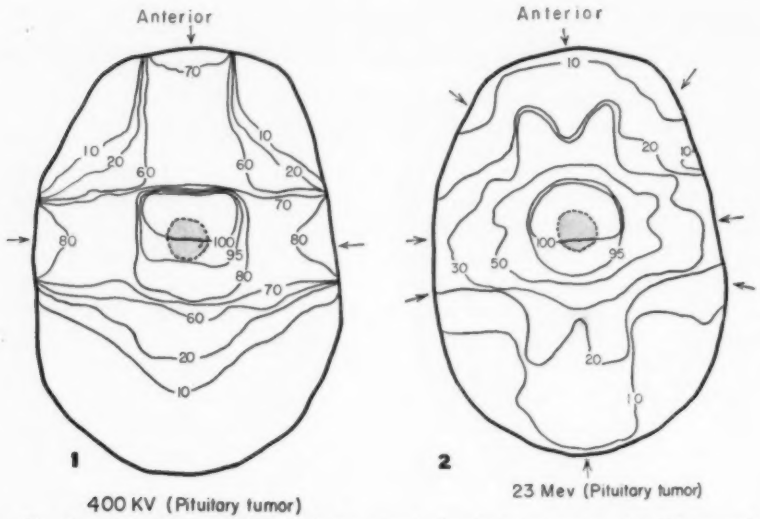
5. Relative absorption of the radiations is high in bone and low in fat at lower voltages; it is more nearly equal with the betatron (3, 6).

For practical purposes we have selected 5 patients treated with the betatron and have compared their actual dose distributions with those which might have resulted from the use of the lower-energy machine.

These patients had tumors located in different parts of the body and in both central and eccentric position. Treatment planning was conducted in a routine fashion and without thought or reference to competing methods, with the exception of one chest case for purposes of demonstration. The number of fields of treatment differ with the two technics, simply because the 23-mev x-rays have so much greater range that one has an almost unlimited number of approaches to a lesion. The number of treatments, size of daily treatments, rate of dosage administration, and over-all treatment period in terms of weeks are not significantly different between the two methods.

The method of depth dose calculation and distribution involves the construction of scale drawings on transparent paper, of transverse, sagittal, and coronal sections of the tumor-bearing area. As a preliminary measure to determine the optimum size and arrangement of portals, the area to be treated, including a zone 1

[1] From the Department of Radiology of the University of Illinois College of Medicine, Chicago, Ill. Presented in the Section on Radiology at the Annual Meeting of the American Medical Association, Atlantic City, N. J., June 14, 1951. Accepted for publication in July 1951.



Figs. 1 and 2. Dose distribution in treatment of a pituitary tumor with 400-kv. and 23-mev betatron x-rays. The stippled area represents the tumor zone. Dose distribution lines show the radiation received by the tumor and normal tissues.

The higher-energy x-ray beam distribution (Fig. 2) shows slightly better tumor coverage by the 100 per cent area, a slightly better centered 95 per cent zone, and much greater fall-off in surrounding normal tissues. One vertex port was included in the lower-voltage calculations and two vertex ports were used with the betatron. These are not indicated in the illustrations.

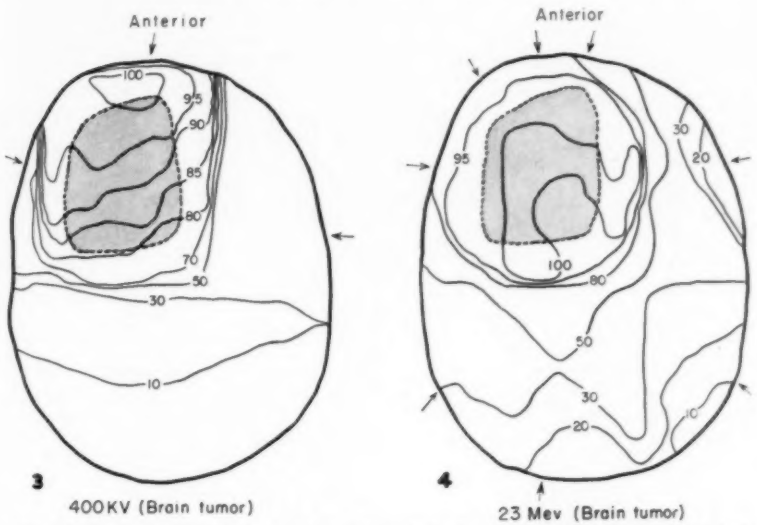
cm. in width around the tumor, was divided into 4-cm.-square areas, and the total depth dose was determined at each corner of the squares. When the optimum arrangement of portal size and location consistent with practical radiological procedure had been thus achieved, the sections were subdivided into 1-cm.-square areas, and the depth doses from all portals totaled at each corner of these squares. The isodose curves were then drawn through the appropriate points, completing the depth dose distribution.

In calculating contributions from beams that were not in the plane of the majority, the dose at the mid-tumor level was used, and this was averaged for obliquely directed beams.

Case 1 is a pituitary tumor. The dose distribution with 400,000-volt x-rays is shown in Figure 1 and with the 23,000,000-volt betatron in Figure 2. The lower-voltage treatment was administered through 4 fields, 4 × 6 cm., including a vertex field not shown in the illustration. Ten circular fields of 5 cm. diameter were used with the betatron, including two vertex fields not shown in the illustration. In both instances the tumor is well covered by the 95 per cent zone. A sharp decline in dosage gradient is shown with the betatron method; the maximum skin dose is about 20 per cent with the betatron and 80 per cent with the lower-voltage radiation.

Case 2 is a frontal lobe brain tumor, for which the dose distributions are shown in Figures 3 and 4. Four fields, 8 × 10 cm., were used with the lower voltage and 9 circular fields of 10 cm. diameter with the betatron. A vertex field was included in each instance but is not indicated in the illustrations. The lower-voltage treatment yields a tumor dose ranging from 100 per cent down to 80 per cent, while the betatron shows a dose of 95 per cent or more throughout the tumor and adjacent normal zone. The anterior skin received 95 per cent dose with the lower voltage and 80 per cent of maximum with the betatron. Both technics show a rapid fall in dose outside the tumor area.

Case 3 is a mediastinal tumor, for which

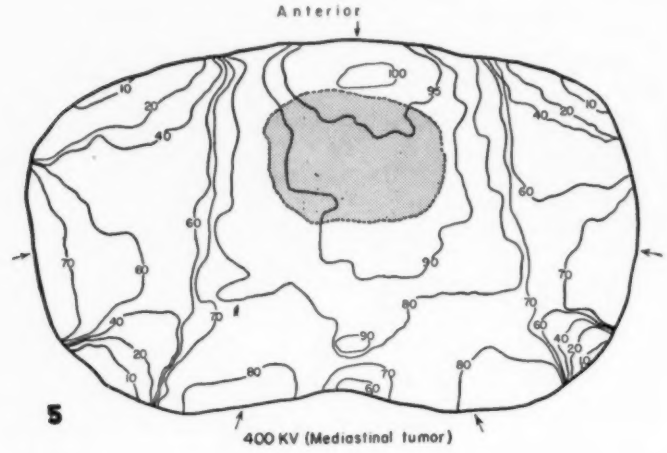


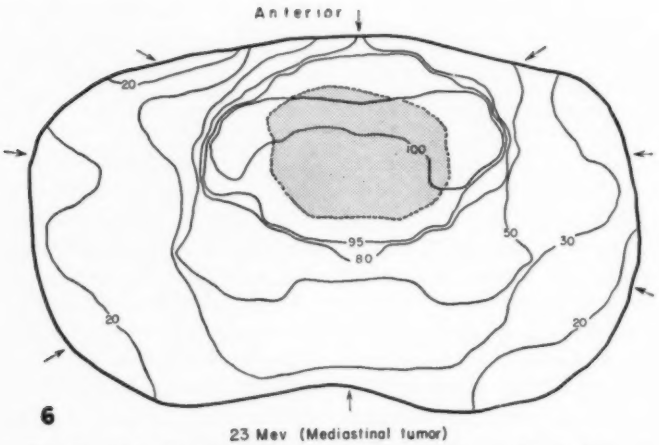
Figs. 3 and 4. Dose distribution in treatment of a frontal lobe brain tumor with 400-kv. and 23-mev betatron x-rays. With 400 kv. (Fig. 3) tumor dose distribution is far from ideal. It varies from 100 per cent anteriorly to 70 per cent posteriorly. Excellent dose distribution was obtained in and around the tumor with 23-mev radiation. A vertex port was used in both instances but is not indicated in the drawings.

the dose distributions are shown in Figures 5 and 6. Five fields, 10 × 15 cm., were used to illustrate the result of multiple fields at lower voltage, although in actual practice we would not use so many. Treatment with the betatron was given through 6 lateral fields of 10 cm. diameter, and an anterior and a posterior field, each of 15 cm. diameter. The anterior and posterior fields received double the dose delivered to the lateral fields. The lower-voltage treatment yields a tumor dose varying from 95 to 80 per cent, with the adjacent healthy tissue in the 80 per cent range. The betatron tumor dose is 95 per cent or above and there is a rapid dose decline in healthy tissue beyond the tumor zone. The skin anteriorly receives 95 per cent and elsewhere at least 70 per cent with the lower-voltage irradiation, and 80 per cent in one spot anteriorly and less than 20 per cent elsewhere with the betatron.

Case 4 is a tumor in the posterior upper thorax. Dose distributions are shown in Figures 7 and 8. Four 8 × 10-cm. fields were used at 400,000 volts and 8 circular fields, 10 cm. in diameter, with the betatron. The anterior and posterior fields received double doses with the betatron. The lower-voltage treatment shows 70 to 95 per cent distribution in the tumor, at least 60 per cent in healthy irradiated tissue, and a maximum of 70 per cent on the skin. The betatron delivers a relatively homogeneous dose in the tumor in the 95 per cent zone, with a sharp falling off outside the tumor zone; only two skin areas receive a dose up to 50 per cent of maximum.

A comparison of dose distribution for a bladder tumor is given in Figures 9 and 10. Treatment was given through 4 fields 8 × 10-cm. plus a 6 × 8-cm. perineal field with the lower-voltage technic. Compression was used where possible. The perineal field received only one-third of the dose for the other fields, due to the lack of skin tolerance in this area. The 100 per cent zone falls outside the tumor, which is included in the 90 per cent zone. Most of the irradiated healthy tissue received at least 50 per cent of maximum dose. The skin in the treated areas received approximately 70 per cent of maximum dose. With the betatron technic, 10 circular fields, 10 cm. in diameter,

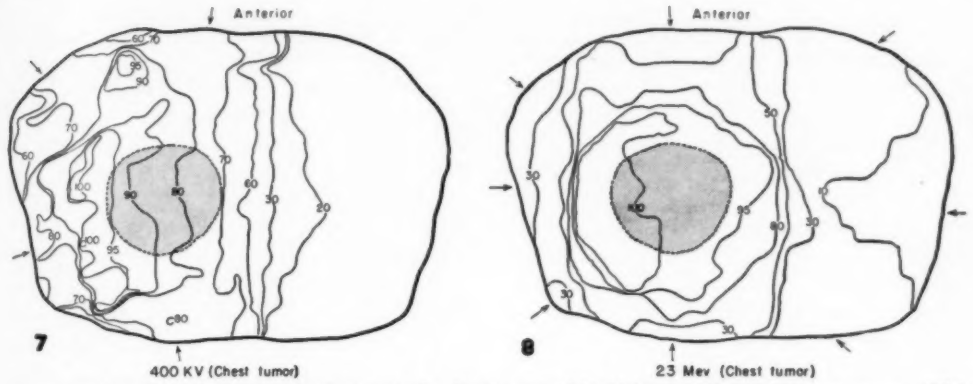




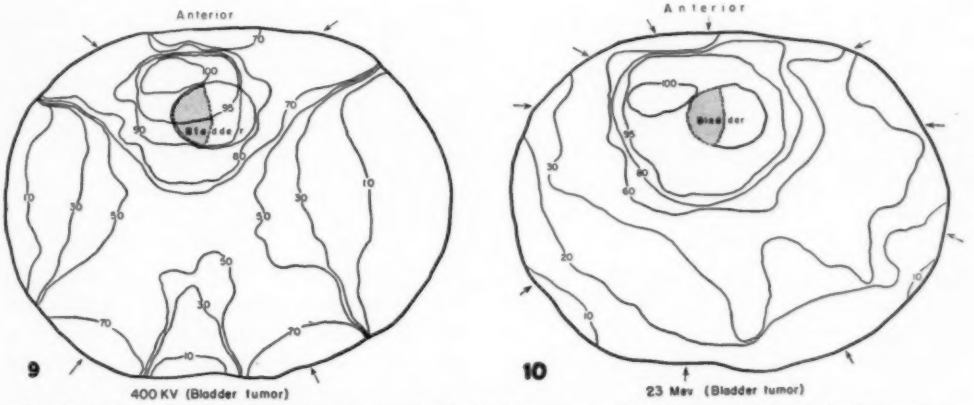
Figs. 5 and 6. Dose distribution in treatment of a mediastinal tumor with 400-kv. and 23-mev betatron x-rays. With the lower voltage (Fig. 5) distribution varies considerably in the tumor zone, and fall-off is slow in the normal tissues. With the betatron (Fig. 6) the tumor and adjacent normal zone show an excellent coverage, and there is a rapid fall-off of dosage in other normal areas.

were used. While the tumor falls outside the 100 per cent zone, it is included in the 95 per cent area. Again a sharp decline in dose occurs outside the tumor area and only a small portion of the skin of the anterior abdominal wall receives an appreciable percentage of maximum dose (60 per cent).

The isodose charts shown in Figures 1 to 10 provide a qualitative representation of treatment in a two-dimensional plane through the lesion. It is desirable to assess quantitatively the physical characteristics of a treatment in such a way as to consider the whole treatment in three dimensions. For this purpose we have determined integral dose, tumor dose, and irradiated healthy tissue dose. The integral dose was calculated according to the method of Mayneord (5). The total integral dose contains the contribution of all the fields weighted according to the relative number of times used. It can be broken down into integral dose to the



Figs. 7 and 8. Dose distribution in treatment of a chest tumor with 400-kv. and 23-mev betatron x-rays. With treatment at the lower voltage (Fig. 7) the tumor area shows considerable variation in dose levels, and the normal tissues show a large dose. With 23 mev (Fig. 8), the tumor and adjacent zone are well covered and there is a steep fall-off in dose in surrounding normal areas.



Figs. 9 and 10. Dose distribution in treatment of a bladder tumor with 400-kv. and 23-mev betatron x-rays. At the lower voltage (Fig. 9) the tumor zone is not ideally covered and normal tissues receive a large dose. (A perineal port was also used.) With the 23-mev radiation (Fig. 10) the tumor area is uniformly covered and normal tissues show a steep gradient.

tumor and to the healthy irradiated tissue. The total volume of irradiated tissue was determined by assuming it to be a cylinder. An average of the height of the cylinder and the surface area determined with a planimeter were used in the calculation. The tumor volume was assumed to be a sphere, which included 1 cm. of surrounding tissue, and this volume was subtracted from the total volume to determine the volume of irradiated healthy tissue. The results of calculations are set forth for the 400,000-volt treatments in Table I and for the 23,000,000-volt betatron treatments of the same 5 patients in Table II.

The procedure in the calculations can best be outlined with reference to successive columns in Tables I and II. The total integral dose is tabulated in the second column for the treatments as detailed in the description above. For the 400-kv. treatments the quantity was calculated from the equation derived by Mayneord (5) for each field used:

$$\text{I.D.} = 1.44 D_0 A d_{1/2} \left\{ 1 + 2.88 \frac{d_{1/2}}{f} + 2.88 \left(\frac{d_{1/2}}{f} \right)^2 \right\} \quad (1)$$

where D_0 is the skin dose, A is the area of

TABLE I: DOSAGE DATA FOR 400 KV.
(r = Skin dose in roentgens. I.D. = Integral dose)

1 Tumor Location	2 Total I.D. (gram-r/ r 50 cm.)	3 Tumor Volume (c.c.)	4 Average Dose in Tumor (roentgens)	5 I.D. of Tumor (gram-r/ r 50 cm.)	6 I.D. of Healthy Tissue (gram-r/ r 50 cm.)	7 Unique Volume (c.c.)	8 Average Dose in Healthy Tissue (roentgens)	9 Total gram-r/r Tumor (gram-r/r)	10 Average Dose in Healthy Tissue per Tumor Dose (per cent)
Pituitary	943	33.5	1.35	45	898	1,778.5	0.51	698.5	38
Brain	3,888	196	1.80	353	3,535	4,202	0.82	2,160	46
Mediastinum	12,408	697	1.19	829	11,579	11,539	1.00	10,428	84
Posterior thorax	4,416	382	1.39	531	3,885	4,324	0.90	3,177	65
Bladder	4,915	180	1.16	209	4,706	7,911	0.60	4,237	52

TABLE II: DOSAGE DATA FOR 23-MEV (BETATRON)
(r 84 cm. = Reading of 25 r Victoreen thimble chamber centered in an 8-cm. lucite cube at 84 cm. target-skin distance. I.D. = Integral dose)

1 Tumor Location	2 Total I.D. (gram-r/ r 84 cm.)	3 Tumor Volume (c.c.)	4 Average Dose in Tumor (roentgens)	5 I.D. of Tumor (gram-r/ r 84 cm.)	6 I.D. of Healthy Tissue (gram-r/ r 84 cm.)	7 Unique Volume (c.c.)	8 Average Dose in Healthy Tissue (roentgens)	9 Total gram-r/r Tumor (gram-r/r)	10 Average Dose in Healthy Tissue per Tumor Dose (per cent)
Pituitary	2,943	33.5	8.40	281	2,662	1,772.5	1.50	350	18
Brain	10,737	196	7.53	1,476	9,261	4,154	2.23	1,426	30
Mediastinum	26,163	697	6.21	4,328	21,835	8,963	2.46	4,213	40
Posterior thorax	17,506	382	6.94	2,651	14,855	5,234	2.84	2,522	41
Bladder	18,715	180	7.08	1,274	17,441	7,458	2.34	2,643	33

the field, $d_{1/2}$ is the depth for 50 per cent relative depth dose, and f is the target-skin distance. The values of $d_{1/2}$ were taken from isodose charts obtained from the Hospital Physicists' Association of England. For our calculations D_0 was arbitrarily taken as 1 r for each field for each time it was used. The number of different fields employed, together with their weighting, is detailed in the treatment section above. For 23-mev x-rays the integral dose was determined conveniently from graphs constructed according to the relation:

$$\text{I.D./cm}^2 = \left(\frac{S+4}{S}\right)^2 \frac{1}{e^{-4\mu} - e^{-4\mu_s}} \times \left\{\frac{1}{\mu_s} - \frac{1}{\mu} + \frac{1}{\mu} e^{-\mu s x} - \frac{1}{\mu} e^{-\mu x}\right\} \quad (2)$$

where S is the target-skin distance and μ and μ_s are empirical coefficients determined from depth-dose data (2, 3). For field sizes above 5 cm. in diameter $\mu = 0.024$ cm.$^{-1}$ while $\mu_s = 0.80$ cm.$^{-1}$. Use of these values for μ and μ_s permits the construction of a single graph of per cent of total integral dose as a function of depth in tissue. Equation 2 yields the integral dose up to any depth in tissue for a given field, in gram-roentgens per roentgen delivered 4 cm. below the skin. The total integral doses in Column 2 result from the addition of the contributions by each of the fields employed as specified in the treatment details above. Since the target-skin distance was 80 cm. for the 23-mev x-rays, the values in Column 2 are in gram-roentgens per 1 roentgen at 84 cm. for each field each time employed.

Column 3 shows the tumor volume in cubic centimeters.

Column 4 indicates the average tumor dose obtained with the specified treatments. For the 400-kv. x-rays this treatment amounts to 1 roentgen skin dose for each field each time employed. For the 23-mev x-rays the basis is 1 roentgen

at 4 cm. depth for each field each time employed.

The resulting tumor integral doses are given in Column 5 for the specified treatments. This quantity is the product of Columns 3 and 4 and assumes a density of 1 gram/c.c. for the tumor tissue.

The integral dose of the irradiated healthy tissue is then obtained as the difference of the total integral dose and the tumor integral dose. These values are tabulated in Column 6. Since the tumor doses are not the same, these integral doses in Tables I and II cannot be compared directly.

The quotient of the integral dose of the irradiated healthy tissue (Column 6) and the corresponding volume (Column 7) yields the average dose in this healthy tissue unavoidably exposed for the specified treatments. These average doses are expressed as a percentage of the tumor dose in Column 10. These percentages can be compared between the two tables.

The ratios of the total integral dose to the tumor dose are also of interest and are tabulated in Column 9.

Although the total integral dose is an important physical criterion, it is not sufficient. This is apparent from the fact that the minimum integral dose will always be achieved with but one field, whereas the preferred treatment usually requires multiple fields. It is actually the integral dose of the irradiated healthy tissue which should be minimized with respect to the tumor dose. The expression of this quantity as the average dose is more useful and gives weight to the advantage of multiple fields by emphasizing the distribution of the extra-lesion dose over a large volume. The criterion of low average dose in the irradiated healthy tissue relative to the tumor dose is thus believed to evaluate quantitatively the merit of a radiation treatment as far as the dose distribution is concerned.

SUMMARY AND CONCLUSIONS

Dose distributions of high-energy x-ray beams are best evaluated in terms of tumor dose, integral dose, and average dose in healthy tissues unavoidably irradiated in the treatment of a neoplasm. Tumor dose itself is not an adequate description of a treatment, since it may vary by as much as 30 per cent in different areas in the same tumor, particularly at lower energies. The variation is usually less than 5 per cent at high-voltage levels such as are attained with the betatron. The total integral dose, though important, is also an inadequate description of the treatment, since its maximum value does not correspond with the best dose distribution. The average dose unavoidably delivered to healthy tissues is an important criterion in the evaluation of radiation treatment at any energy level. The lower this dose is, the fewer the symptoms of radiation sickness the patient will probably experience, and the greater will be the healing of the tumor bed.

The 23-mev betatron x-ray beam produces a more uniform tumor dose in most internal neoplasms, a lower integral dose per tumor dose, and a lower average dose in healthy tissue unavoidably irradiated than does the 400-kv. machine.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Comparación de la Distribución de las Dosis en Enfermos Tratados con Haces de Rayos X de Energías Muy Distintas

La distribución de las dosis de haces de rayos X de alta energia se justiprecia mejor en términos de dosis tumor, dosis "íntegra" y dosis media en los tejidos sanos inevitablemente irradiados al tratar una neoplasia. La dosis tumor no constituye en sí una descripción adecuada del tratamiento, pues puede variar hasta en 30 por ciento en diversas zonas del mismo tumor, sobre todo con los valores más bajos. La variación suele ser de menos de 5 por ciento con voltajes altos como los que se obtienen con el betatrón. La dosis "íntegra," aunque importante, también aporta una descripción inadecuada del tratamiento, pues su valor máximo no corresponde al de la distribución de la dosis óptima. La dosis media llevada inevitablemente a los tejidos sanos representa una pauta importante en la valuación de la radioterapia de cualquiera energía. Mientras más baja, menores serán los síntomas de enfermedad irradiatoria que probablemente experimentará el paciente, y mayor será la curación del lecho del tumor.

Cinco casos tratados con el betatrón fueron escogidos para hacer una comparación entre la distribución real de la dosis y la que hubiera podido obtenerse con el empleo de un aparato de 400 kv. de rayos X. Dedúcese que el haz de rayos X de un betatrón de 23 mev produce una dosis tumor más uniforme en la mayor parte de las neoplasias internas, una dosis "íntegra" menor por dosis tumor y una dosis media más baja en el tejido sano.

Radiation Hazards to the Embryo and Fetus[1]

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THE RADIOSENSITIVITY of the embryo and fetus is a matter of great practical importance to radiologists, gynecologists, and obstetricians. It is unfortunate, therefore, that the literature on this subject is diffuse and contains numerous apparently contradictory reports and opinions. Cases of grave radiation injury to the embryo or fetus have been summarized and discussed by Goldstein and Murphy in 1929, Gauss (quoting a thesis by Kraemer) in 1930, Flaskamp in 1930, and Miller, Corscaden and Harrar in 1936. Since the time of these reviews, more cases have been described by Murphy, Shirlock and Doll (1942), Jones and Neill (1944), and others. On the other hand, there are scattered reports of normal births following heavy doses of radiation: Robinson (1927) has collected 23 such cases from the earlier literature, Lacomme (1931) reports 2 and Hobbs (1950) 1.

Results from recent extensive animal experiments fall into an easily comprehensible over-all picture which dispels some of the apparent contradictions in the human data. Conclusions from this more unified view will be discussed here and will form the basis for practical recommendations which, in the authors' opinion, may protect the well-being of many unborn infants in this age of increasing use of radiation.

The earliest animal work was almost exclusively concerned with the production of abortions and resorptions. Somewhat later investigators—*e.g.*, Pagenstecher, working with rabbits (1916), and Hanson (1923), Bagg (1922), Murphy and de Renyi, working with rats (1930)—reported a variety of scattered abnormalities. Although this work was valuable in showing that malformations could be produced by prenatal irradiation, it lacked the important feature of accurate timing of the stage of gestation at which irradiation was done. Job, Leibold, and Fitzmaurice (1935) were the first who attempted to determine whether there were critical periods in development, either for the mammalian embryo as a whole or for certain of its organs or systems. Although a good part of the work was exploratory, they were able to correlate irradiation of rat embryos on the ninth, tenth, and eleventh days postconception with the later appearance of hydrocephalus, eye abnormalities, and jaw deformities, respectively. Kaven (1938), working on another species, the mouse, lengthened the list of abnormalities for which critical periods were probably demonstrable. He found brain hernia and "*extrakranielle Dysencephalie*" produced exclusively by irradiation on the seventh and eighth days, tail malformations resulting from irradiation between the ninth and thirteenth days, and indications of the existence of critical periods for several other abnormalities.

Three years ago we embarked on an extended series of experiments, the first part of which was a careful mapping of periods critical for the induction of abnormalities by radiation in the mouse (Russell, 1950). In general, the method was to irradiate groups of pregnant females in different stages of gestation differing by twenty-four-hour intervals and ranging from half a day after fertilization to term. Each female (and, therefore, each embryo or fetus) was irradiated only once. Several measures were taken to insure a maximum of accuracy and reliability: (1) careful timing of mating by the vaginal plug method; (2) the use of genetically pure material so that any abnormalities related to genetic constitution rather than x-ray ex-

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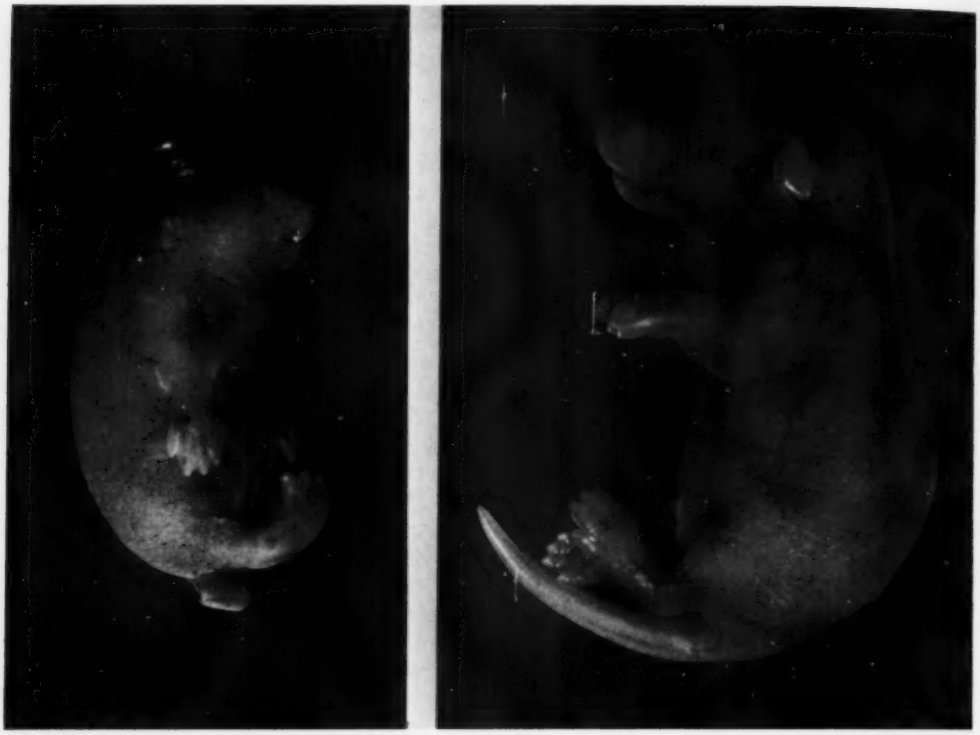

Fig. 1. Newborn mouse which had been irradiated ten and a half days postconception with 300 r (left), compared with control newborn (right). Note size reduction and change in body shape; rigid elbow joint; rotated heels; abnormal feet; short, coiled tail; microcephaly; bulging of brain through defective cranium; open eyelids (abnormal for newborn mouse).

posure would become apparent in the large control group; as a genetic "trick" we used an F_1 hybrid between two inbred strains, thus combining hybrid vigor with uniformity; (3) uniformity in parity of the pregnant mothers; (4) large numbers: 420 in the experimental group, 372 controls; each of these animals was observed for about 100 characters, three-fourths of them skeletal.

The first problem was to find a dose sufficiently low to permit survival to term, yet high enough to cause numerous obvious abnormalities at that time, but, again, not so high as to result in confusion of effect. The importance of this last point became apparent from the work of Warkany and Schraffenberger (1947) who, by irradiating rats between the tenth and sixteenth days of gestation, had produced a great variety of abnormalities with the high dose range of 190–1,120 r but had, in most instances, failed to demonstrate sharply defined critical periods. Our own work later showed that primordia are slightly sensitive at stages adjacent to that of maximum susceptibility, so that with a high enough dose a response may be evoked throughout an extended period. Preliminary results indicated 200 r to be well suited for a general survey, but other doses also were used for purposes of comparison.

Detailed descriptions of the results may be found in the original reports on the experiment (Russell, 1950 and 1949). The main point for the present discussion is that it was possible to mark *very clearly defined critical periods* for almost all the abnormalities obtained. Thus, for example, 16 out of 41 animals irradiated at nine and a half

days postconception had spina bifida at birth, while none of 379 animals irradiated on other days and none of the 372 controls showed this abnormality. Similar correlations with definite treatment days could be described for such externally visible and visceral abnormalities as microphthalmia, coloboma, narrow iris, vaulted cranium, central approach of nostrils, brain hernia, imperforate anus, hydronephrosis, hydroureter, oligodactyly, polydactyly, and tail and limb deformities. If skeletal characters, on which the bulk of the study was made, were to be included here, the list would be more than ten times as long. As one example of the variety of abnormalities produced, Figure 1 shows an external and Figure 2 a skeletal comparison between a control and an abnormal newborn animal which had been irradiated at ten and a half days postconception. At this stage of irradiation, there is an overlapping of many critical periods. Details will be found in the legend.

Certain conclusions about the etiology of some of the abnormalities may be drawn from a consideration of what developmental events, involving the appropriate primordium, occur at the time determined to be critical. In many cases, sensitivity is clearly correlated with a high rate of change in the developing organ. Thus, for example, oligodactyly may be induced by irradiating at the time the limb buds embark on their growth, the closeness of the parallelism becoming apparent in the fact that the forefeet are sensitive slightly earlier than the hind feet. This supports the classical concept (Child, 1913; Stockard, 1921) that the grades of sensitivity of different primordia to any detrimental agent are proportional to the rate of metabolism or rate of cell division. On the other hand, our work also provided examples of abnormalities in which the critical period could not have been predicted from the visibly fastest rate of what would have seemed the most obvious precursor process, but could be correlated with other, less obvious processes instead. However, rather than to discuss the many embryological interpretations which can be made from the results so briefly summarized here, the purpose of this review is to make immediate practical applications of the animal results to human cases.

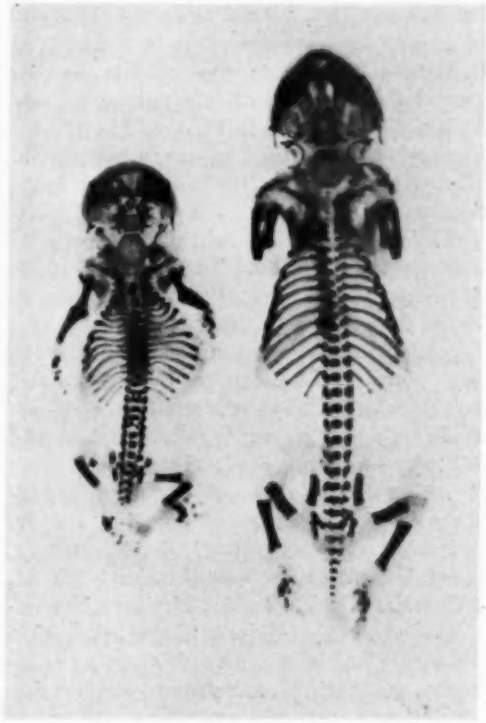

Fig. 2. Skeletal comparison of mice similar to those shown in Figure 1. Note that hardly a single bone in the animal on the left is normal. The following changes are among the more obvious ones: cleft palate; reduced scapula; wide, flat thorax with angulated and broken ribs and a reduced number of sternebrae; splitting and fusion of vertebral centra; drastic reduction of both ilia and of right femur; fusion of humerus with radius and ulna. Many other changes could be enumerated but are not so clear on the photograph.

Note that this very abnormal type of animal is born rather than aborted or resorbed. The postfertilization day ($10^1/_2$) on which this mouse was irradiated, corresponds to four weeks after conception in human gestation. By that time, few women realize that they are pregnant and the embryo may thus be unknowingly exposed to radiation (see text for recommended procedure). Although 300 r was used to produce the extremely abnormal mouse illustrated above, 25 r can cause detectable changes if administered at critical developmental stages (see text).

The authors are grateful to Messrs. J. E. Westcott and J. P. Tarver of the Office of Public Information of the Atomic Energy Commission in Oak Ridge for photographing these skeletal preparations.

First of all, there can be no question that the human embryo is subject to severe

radiation injury, for not only has this type of injury been observed in a variety of mammals (mice, rats, and rabbits, as discussed above; also noted in guinea-pigs by de Nobele and Lams in 1925, and in cats by Tousey in 1905), but in every vertebrate class—from fishes to birds—and in a large number of invertebrate forms. It is highly unlikely that man would differ from all animals investigated. The reported cases of presumed radiation injury to human embryos or fetuses bear out this view. The types of human abnormalities that have been enumerated in the case literature and in the reviews cited above include microcephaly (which, according to Goldstein and Murphy—who have been very conservative in ruling out other possible causative factors—is the most frequent result of irradiating the conceptus), hydrocephaly, mental deficiency, coordination defects, mongolism, spina bifida, skull malformations, ossification defects of the head, cleft palate, blindness, microphthalmia, coloboma, cataract, chorioretinitis, strabismus, nystagmus, ear abnormalities, deformed arms, clubfeet, hypophalangism, genital deformities, and general mental and physical subnormality.

What use can be made of the critical period concept as far as the question of human hazards is concerned? Time intervals in human prenatal development, which spans thirty-eight weeks, and in mouse development, which is completed in ess than three weeks, are not directly proportional. For example, the first one-fourth of mouse prenatal life is equivalent to only the first one-thirtieth of that for man. However, since there are many meaningful cross-reference points or "milestones" in development (such as gastrulation, neural tube formation, and beginning of segmentation), it is possible to estimate what point in human gestation corresponds to any given stage in the mouse. By plotting over 80 such cross-reference points, Otis (1949) obtained a remarkably smooth curve. On the basis of this, it would be theoretically possible to predict when the critical period for the production of any one abnormality determined in the mouse should occur in man. This is much too extensive a comparison to be covered in this review. The main and important generalization which can, however, be stated is that the abnormalities that we have studied, all of which are observable at birth, and usually as conspicuous changes, have critical periods occurring in an interval which corresponds to week two to six postconception in man, *i.e.*, the time of major organogenesis. This does not mean that sensitive stages for other processes do not occur later in the course of pregnancy, but that interference with these processes is less apt to lead to extreme monstrosities.

It is interesting to note that Kraemer (1931), who grouped reported cases of post-conceptional irradiation according to the time in gestation at which it had been administered, found that damage resulted in all of 11 cases in which irradiation was done within the first and second months, while only 7 out of 11 (64 per cent) fetuses irradiated between the third and the fifth months and 3 out of 13 (23 per cent) irradiated between the sixth and tenth months were abnormal at or near term. Other compilations, in which the gestation period was divided only into larger groupings, point in the same direction. Thus, of the 28 definite cases of prenatal radiation injury summarized by Goldstein and Murphy (1929), 22 (79 per cent) had a history of irradiation prior to the fifth month; and all the 8 severely defective cases compiled in Robinson's (1927) list of 33 post-conceptional treatments had been irradiated before three and a half months. Of particular interest is the case of Feldweg (1927) in which the irradiation was known to have been given in the fourth or fifth week. The resulting arm abnormalities of the newborn are similar to those which can be produced in the mouse by treatment at the corresponding stage, ten and a half days (see Figs. 1 and 2).

The animal results which point to the second to the sixth week as the most susceptible period for the induction of monsters in man are highly important from a prac-

tical point of view. Many radiologists, aware of possible dangers to the fetus will, whenever possible, avoid irradiation of pregnant women. However, for at least the earlier part (two to four weeks postconception) of the most susceptible time most women are *not yet aware that they are pregnant*, for it is too early for diagnosis, either by missed menstrual periods or by pregnancy tests.

The following procedure is, therefore, to be highly recommended: Prior to pelvic irradiation of women of childbearing age, the radiologist should always inquire whether there is even the remotest possibility of a very early pregnancy. The safest procedure is to restrict pelvic irradiation, whenever possible, to the two weeks *following* menstruation, as there is almost no chance of an unsuspected pregnancy during that time (ovulation probably occurring half-way between menstrual periods). The idea of timing a clinical procedure with respect to the menstrual cycle is not a new one: a similar practice is already being followed for dilatation of the tubes in sterility tests.

It is, of course, obvious that in some cases, where pelvic irradiation is indicated for therapeutic purposes, it cannot be postponed. Whether or not, in such cases, the physician would follow various practices suggested by earlier authors—such as inducing abortion before or after irradiation (Flaskamp, 1930), doing a routine curettage following all uterine irradiation (Gauss, 1930), or preceding radiation therapy (Murphy, 1929), or later terminating a pregnancy which was unsuspected at the time of irradiation (Murphy, 1929; Gauss, 1930), or which radiation failed to terminate (Robinson, 1927)—would depend on legal and ethical considerations and whether or not the condition calling for pelvic radiation therapy would in itself call for an abortion. Our main concern here is with diagnostic irradiation, such as gastro-intestinal series, which could be postponed until there was no danger of the unsuspected presence of an embryo in its most susceptible stages. As will be discussed later, doses of the levels used in some fluoroscopic examinations have been shown to have some effect on the embryo.

The emphasis has been placed on critical stages that occur in the early part of gestation. It has, however, been mentioned that abnormalities are also induced by later irradiation, although they are not likely to be so extreme and may not even be apparent at term. In our own mouse work (1950) it was found that following x-ray exposure at later stages, corresponding to periods *after* the sixth week in human pregnancy, no effects of the types looked for (skeletal, external, gross visceral) were detected *at birth*. Within a few weeks, however, the mice began to show cataracts, hydrocephalus, behavior disturbances, and skin lesions. Bagg (1922) found malformations of eyes, brain and gonads in later life from irradiation of rat fetuses shortly before term. In a more recent study (Hicks, 1950), exposure of rats in the later stages of pregnancy to x-ray doses of 200 r and above yielded 100 per cent brain damage and a high percentage of damage to the spinal cord and the retina of the fetuses. On the basis of these animal results, one may thus predict that, while irradiation between the second and sixth weeks of human gestation will probably produce marked changes, later exposure will tend to cause less obvious effects, some of which may not become apparent until later in life. From a human point of view, therefore, the dangers of later irradiation must not be ignored. Less emphasis has been placed on them here, since they involve a time when there need no longer be any doubt of pregnancy, and are, therefore, already avoided in good current practice.

The statement has occasionally been made (Robinson, 1927, and others) that any dose high enough to cause maldevelopment of the conceptus will also lead to abortion and thus presents no appreciable hazard. This is certainly not true in the mouse (Russell, 1950), where irradiation at any time after implantation, with doses amply sufficient to produce up to 100 per cent of a great variety of abnormalities (200 r and

300 r; 400 r in a few cases), causes only a negligible amount of prenatal mortality. Viability at birth, following irradiation at certain specific prenatal stages, is poor, but other animals, irradiated at different stages, will live and grow up (even though in a frequently stunted condition) in spite of their very obvious abnormalities. A similar situation probably exists in man. Murphy (1929) showed that the abortion rate following post-conceptional irradiation was probably no higher than in the population at large, and among 74 fetuses who went to (or near) term, there were no stillbirths; yet 34 per cent of the children were grossly deformed. Many of these children, moreover, survive for considerable periods after birth. Thus, in Goldstein and Murphy's series, 19 of 26 monstrous children were alive, more than half of these being two to twelve years old at the time of the report. On the other hand, certain authors (*e.g.*, Mayer, Harris, and Wimpfheimer, 1936) report a very high percentage of success in using maternal irradiation as a means of inducing abortion. Whether the discrepancy between their results and the cases collected by Murphy are due to difference in dose (Mayer *et al.* used 600 r at the depth of the uterus) or stage administered cannot be determined from the data as cited. The important conclusion, however, is that damaged embryos or fetuses *do* come to term, at least in a large number of cases.

Animal experimentation revealed only one clear-cut instance in which irradiation leads to prenatal death, and that concerns exposure at the very beginning of pregnancy, *i.e.*, during the preimplantation period, which in man probably spans no more than ten days. Our recent work (Russell and Russell, 1950*a*) has shown that 200 r during that time reduces the net output per female by as much as 80 per cent. This is due to death both before implantation (some of which is probably due to an inability of the maternal uterus to receive the conceptus) and very shortly after implantation. The surviving 20 per cent of the offspring are to all appearance normal, both at term and in later life.

This leads to the question of how much of the radiation effect is directly on the embryo and how much of it is the result of damage to the maternal organism acting indirectly upon the embryo. There is not enough information to decide conclusively on the cause of the failure of implantation, but various considerations make it appear that most of the other effects are directly on the embryo. (1) In the first place, similar types of abnormalities can be produced in embryos of amphibia (and other classes) which are not developing within a maternal body. (2) The clear-cut critical periods demonstrated in our work are further evidence for a direct effect on the embryo: since "radiation sickness" of the mother is probably not sharply limited to less than a day, any major influence of maternal pathological conditions on the development of the embryo would presumably result in a considerably more blurred relation between time of disturbance and effect produced than is actually encountered. (3) Hicks (1950) was able to demonstrate beginnings of necrotic changes in fetal neuroblasts as soon as two hours after irradiation. It is unlikely that indirect effects occurring *via* the mother would become apparent so quickly. Although Job *et al.* (1935) state that shielding the anterior end of the pregnant rat while exposing the abdominal portion protects the litter being carried, the general application of this result must be questioned in the light of the other evidence cited, especially since Wilson (1950), on exposing only part of each rat litter and shielding the rest, obtained abnormalities in the former but not the latter set of embryos. In the majority of human cases reported, the irradiation was to the pelvic region. Evaluation by Schall (1933) of 7 cases of abnormality from irradiation at other sites shows that in only 2 of these can stray irradiation to the uterus be excluded. Archangelsky (1923) suggests that roentgen leukotoxins may be produced in the mother and are responsible for damage to the conceptus. In view of the arguments stated above and the majority of the evidence both in human

cases and animal experiments, it must be concluded that, although radiation effects on the conceptus acting indirectly through the mother cannot be ruled out altogether, the major damage probably occurs through direct action on the embryo and would thus be avoided by appropriate shielding if non-abdominal regions of a pregnant woman had to be irradiated.

Finally, the question of dose must be discussed, especially in its application to diagnostic irradiation, which would, at first glance, appear to be without danger because of the relatively low levels used. After the establishment of critical periods with 200 r, we picked characters suitable for quantitative study and irradiated embryos at the appropriate critical stages with doses of 100 r, 75 r, 50 r, and 25 r (Russell and Russell 1950*b*). Definite effects could be demonstrated even with the lowest dose of 25 r. Since the magnitude of the effect varied continuously with the dose, without evidence of sharp steps or thresholds, there is no reason to doubt that doses lower than 25 r would also lead to changes, which would probably be detected in man, where even subtle defects are likely to be recognized. In a recent survey of 63 fluoroscopic machines in use in New Jersey, Sonnenblick *et al.* (1951) found that about one-fifth emitted more than 30 r per minute, measured at table-top, with one giving as much as 118 r. Since exposure time is frequently a matter of minutes, it is quite clear that, even allowing for dose decrease with depth, 25 r to the embryo falls within the range used in fluoroscopy.

SUMMARY

(1) The developing embryo of a great variety of animal forms studied, including several mammals, is highly susceptible to the induction of malformations by radiation. There is no reason to doubt that this also applies to human embryos.

(2) Animal experiments have clearly demonstrated that there are well defined critical periods in the development of most characters. That is, a particular abnormality may be produced with high incidence by irradiation at a particular stage or stages but not at all from irradiation at other stages.

(3) Critical periods for the majority of gross abnormalities in mice occur at a time which, in man, corresponds to the second to sixth week of gestation. During at least part of this period, pregnancy may still be unsuspected.

(4) Irradiation at more advanced stages (corresponding to periods following the sixth week in man) produces less obvious and possibly more delayed effects which, however, from the human point of view may be as harmful as the gross monstrosities.

(5) Doses high enough to produce developmental abnormalities do *not* necessarily cause abortion or prenatal death.

(6) The major malformations are probably due to direct radiation effect on the embryo rather than indirect action *via* maternal injury.

(7) Doses as low as 25 r have been shown to be effective in producing particular changes if applied at the critical time, and it is quite possible that even lower doses, *i.e.*, well within the range used in diagnostic fluoroscopy, may cause subtle developmental alterations which in the human case would be important.

(8) In view of the observations reported, it is recommended that:

(*a*) Whenever possible, irradiation involving the uterus in women of childbearing age should be restricted to the two weeks following the last menstrual period, to preclude the possibility of fertilization having taken place. This applies particularly to diagnostic irradiation, even if the doses involved are less than 25 r.

(*b*) The present practice of avoiding irradiation during a known pregnancy, *i.e.*, during later stages, should not be relaxed.

(*c*) Whenever possible in non-pelvic irradiation, the conceptus should be shielded.

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SUMARIO

Riesgos que Entraña la Irradiación para el Embrión y el Feto

El embrión en desarrollo de muchas y variadas formas de animales estudiados, incluso varios mamíferos, es sumamente susceptible a la inducción de malformaciones por la radiación. No hay motivos para dudar que esto reza igualmente con los embriones humanos.

Los experimentos en animales han demostrado claramente que hay épocas críticas bien definidas en la producción de la mayoría de los caracteres, es decir, que una anomalía dada puede ser producida en alta incidencia por la irradiación en cierto período o ciertos períodos. Las épocas críticas para la mayoría de las anomalías macroscópicas en los ratones ocurren en una fecha que, en el hombre, corresponde a la segunda a la sexta semana de la gestación. Por lo menos durante parte de ese período, puede que no se sospeche la existencia de embarazo. La irradiación administrada en períodos más avanzados (correspondiendo a más allá de la sexta semana en el hombre) produce efectos menos manifiestos y posiblemente más tardíos que, no obstante, desde el punto de vista humano, pueden ser tan nocivos como las monstruosidades macroscópicas.

Dosis de magnitud suficiente para provocar vicios del desarrollo *no* ocasionan forzosamente aborto o muerte prenatal. Las grandes malformaciones se deben probablemente a efectos directos de la radiación sobre el embrión más bien que a acción indirecta por vía materna.

Está demostrado que dosis hasta de 25 r son capaces de producir alteraciones dadas si se aplican en la época crítica, y es bastante posible que hasta dosis menores, o sean, bien dentro de los límites usados en la roentgenoscopia diagnóstica, ocasionen tenues alteraciones del desarrollo que, en casos humanos, revestirían importancia.

A la luz de las observaciones presentadas, recomiéndase que: (a) Siempre que sea posible, toda irradiación que comprenda el útero en mujeres en la edad de la reproducción se limite a las dos semanas consecutivas a las últimas reglas, a fin de excluir la posibilidad de que haya ocurrido fecundación. Esto reza en particular con la irradiación de diagnóstico, aunque las dosis usadas sean menores de 25 r. (b) No hay que aflojar en la costumbre actual de evitar la irradiación durante un embarazo conocido, es decir, durante los períodos tardíos. (c) Siempre que sea posible en la irradiación extrapelviana, hay que resguardar la concepción.

Goitre Plongeant (Plunging Goiter) Associated with Pharyngo-Esophageal Diverticulum

Report of Case[1]

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IT IS NOT AT ALL unusual to encounter a retrosternal extension of a cervical goiter, but this type, by definition (6), is not usually included in a discussion of intrathoracic goiter. If the latter category is limited to those goiters which lie entirely, or in their major portion, within the thorax, then the incidence of intrathoracic goiter falls sharply. A rare case is encountered in which there is a history of a cervical goiter increasing in size for years, and then permanently disappearing. Rarest of all is the *goitre plongeant* (plunging goiter), initially described and so named by Malard (3), a cervical goiter disappearing within the chest, only to bob up into the neck following a straining effort or during an attack of coughing brought on by a choking spell.

The following case of *goitre plongeant* was encountered in the dispensary of the Maimonides Hospital. It presents an additional novelty in that it was associated with a pharyngo-esophageal (Zenker's, pulsion) diverticulum.

CASE REPORT

A 64-year-old white male, a tailor, complained of difficulty in breathing on lying down and of being awakened from sleep by coughing and choking spells. Thirty-five years earlier he had been told that he had a goiter and had been advised not to have it removed, but the hospital record was not available. Sixteen years before admission he had suffered an attack of "angina pectoris."

For as long as the patient could remember, a "fullness" appeared in the right side of his neck on coughing or straining, but the time-sequence of the development of the cervical goiter, its disappearance, and the reappearance of the mass in the neck could not be accurately determined. He had attended many hospitals and clinics for years, including the Memorial Hospital, New York, and the Kings County Hospital, Brooklyn. Various diagnoses had been entertained, and operation had been suggested but refused. Lately, there had been difficulty in swallowing.

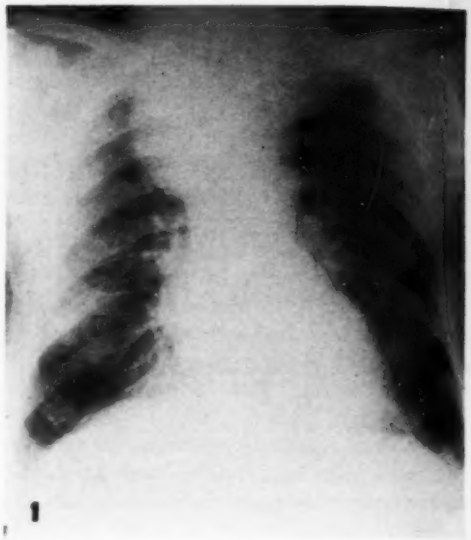

Fig. 1. Conventional chest roentgenogram, showing large globular soft-tissue mass in right superior mediastinum and displacement of trachea to left.

Examination revealed prominent right cervical veins and, on straining, a mass the size of an orange bulged out from the base of the neck, on the right side, causing deviation of the larynx and trachea to the left. A striking picture was presented—the bulging cervical mass, the distended cervical veins, the face flushed, and the eyes suffused with the straining effort.

A conventional chest roentgenogram (Fig. 1) demonstrated a large globular soft-tissue mass in the right superior mediastinum, extending from the level of the upper margin of the clavicle to that of the sixth thoracic vertebra, displacing the trachea to the left. The aortic arch and the pulmonary root shadows appeared normal, but the left supravascular shadow was unusually prominent. On roentgenoscopy there was definite upward movement of the mass with swallowing.

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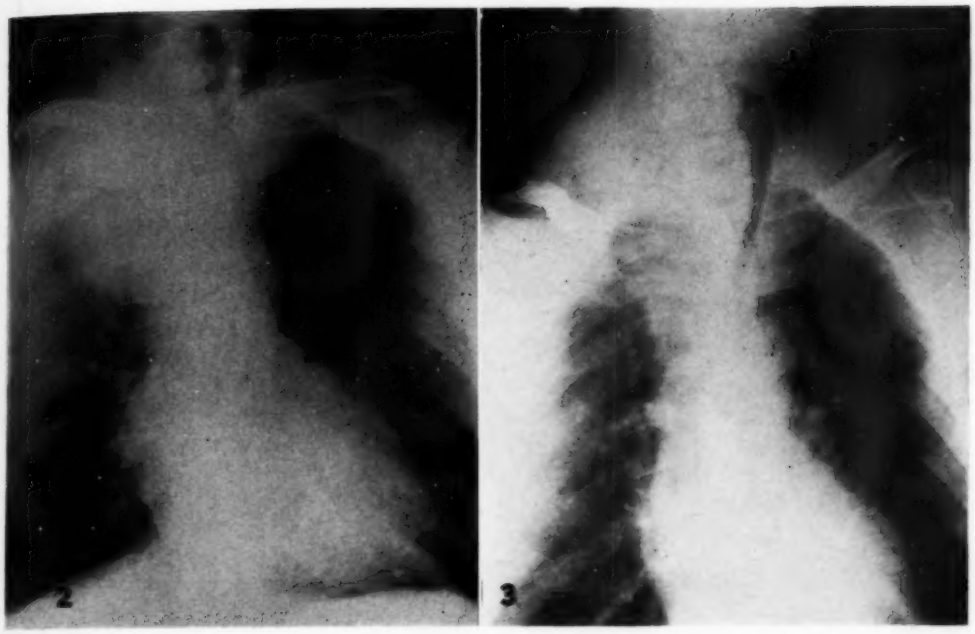

Fig. 2. Five-foot supine Bucky film, with patient at rest, showing extent of right superior mediastinal mass, lateral narrowing and deviation of trachea to left, and pocket of air to left of larynx and cervical trachea.

Fig. 3. Five-foot supine Bucky film, made following Valsalva procedure, showing cephalad shift of soft-tissue mass and apex of tracheal curve, producing conspicuous bulge at right base of neck and in supraclavicular region, tilting of larynx, and increased lateral displacement of air pocket to left of larynx.

A 5-foot supine Bucky film (Fig. 2), made with the patient in a resting state, showed the soft-tissue mass in greater detail, clearly revealing the lateral narrowing and deviation of the trachea to the left, with the apex of the tracheal curvature at the level of the third thoracic vertebra. Also clearly shown was a pocket of air situated to the left of the lower larynx and cervical trachea, above the level of the clavicle.

After the patient took a deep breath and exerted a straining effort, a cephalad shift of the right superior mediastinal and paratracheal mass was demonstrable (Fig. 3), producing a soft-tissue bulge in the base of the neck and the supraclavicular region on the right, increasing the deviation of the larynx and upper trachea to the left, and causing displacement of the apex of the tracheal curvature to the level of the seventh cervical vertebra. The air pocket to the left of the larynx was also elevated and its left lateral displacement was increased.

Anteroposterior and lateral "swimming" position views (Figs. 4 and 5), following a barium swallow, disclosed a typical pharyngo-esophageal (Zenker's, pulsion) diverticulum at the level of the fifth to the seventh cervical vertebra, inclusive, corresponding to the position of the air pocket previously demonstrated and extending to the left and posterior to the cervical esophagus.

A thyroid radioiodine (I^{131}) uptake determination, performed by Dr. Martin Perlmutter of the Radio-Isotope Laboratory, showed the total 24-hour uptake to be 11 per cent, a low normal. "Counts" were obtained only in the isthmus and left lobe of the thyroid, none being obtained in the plunging mass. The opinion was that the mass was not an active thyroid adenoma.

The patient again refused operation. One year later there was no change in his condition.

DISCUSSION

Reference to the initial description of *goitre plongeant* is made by Clute and Lawrence in their paper on "Intrathoracic Goiter" (1), but they do not describe a case of their own. Objection may be taken to the name "plunging" goiter. Actually, the term "bobbing" goiter is more accurately descriptive of the condition, while the appellation *goitre plongeant* is more applicable to those cases in which a cervical goiter has permanently sunk and disappeared below the superior thoracic strait. On the other hand, to call all intrathoracic

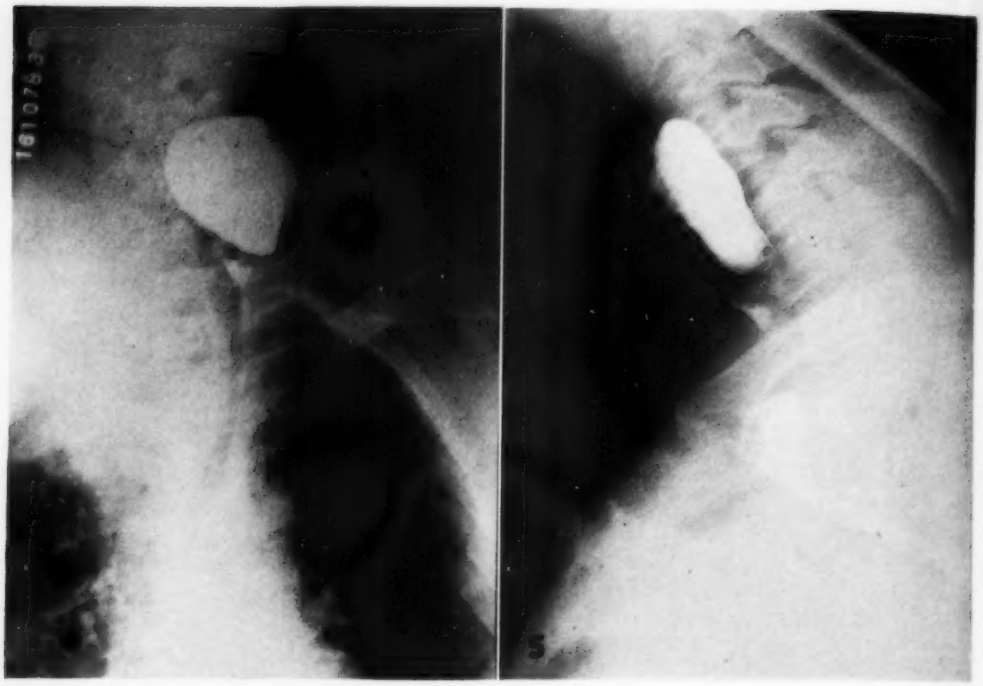

Fig. 4. Anterposterior view, following barium swallow, showing pharyngo-esophageal (pulsion) diverticulum to left of cervical esophagus.

Fig. 5. Lateral, "swimming" position view, showing pharyngo-esophageal (pulsion) diverticulum situated posterior to cervical esophagus.

goiters "plunging," as some writers have done, is misleading.

Wakeley (5) remarks on the relative rarity of *goitre plongeant*. He reports 2 cases encountered in a series of 1,300 goiter operations, and illustrates his article with sketches made from roentgenograms showing cervical goiters with retrosternal extensions. Both patients were women in their forties. One gave a history of a freely movable "bobbing" toxic adenoma for many years, but following a prolonged bout of pneumonia and pleurisy the mass disappeared within the chest and remained there.

Wakeley and Mulvany (6), in a series of 1,265 thyroidectomies, found 3 total intrathoracic goiters, 17 in which the major portion of the gland was intrathoracic, and 91 in which some portion of the swelling was permanently retrosternal. Presumably included in this series were the 2 cases of *goitre plongeant* previously reported by Wakeley. In a review of 908 thyroidectomies performed at the Massachusetts General Hospital, McCort (4) encountered 28 intrathoracic goiters, an incidence of 3.1 per cent, in which the major portion of the goiter lay within the thorax. This author gives an excellent review of the roentgen diagnosis of intrathoracic goiter, but does not elaborate upon or illustrate the one case of *goitre plongeant* included in the series.

The mechanism by which a thyroid adenoma descends into the chest has been described by Wakeley and Mulvany, Lahey (2), and others, and may be synthesized as follows. The lobes of the thyroid lie on the sides of the trachea and esophagus and extend upward on the sides of the pharynx and larynx. They are enclosed, along with these visceral tubes, between the prevertebral fascia posteriorly and the pretracheal

fascia anteriorly, thus being in a fascial plane which enters directly into the superior mediastinum. Adenomatous enlargement of a thyroid lobe is prevented from extending superiorly by the attachment of the sternothyroid muscle to the oblique line on the lamina of the thyroid cartilage, and by the infrahyoid muscles. Lateral and anterior extension are resisted by the carotid sheath and by the sternothyroid, sternohyoid, and omohyoid muscles, which are inserted below and anteriorly into the manubrium and about the sternoclavicular joints. The line of least resistance, therefore, is downward, the infrahyoid muscles acting as a guide into the mediastinum. Flexion of the neck crowds the adenoma through the superior thoracic strait. In an early stage, the adenoma undoubtedly passes freely in and out of the superior mediastinum with flexion and extension of the neck, and with swallowing and respiration. Gravity may also be a factor in its descent. Eventually the enlarging mass is crowded into the mediastinum, the outflaring of the upper portion of the thoracic cage requiring it to be displaced deeper and deeper as it grows. Displacement back into the neck by swallowing, coughing, or by a violent straining effort becomes more and more difficult, and finally the mass is permanently incarcerated within the chest.

In the case reported here, one may predicate secondary cystic degeneration in a previously solid intrathoracic thyroid adenoma, permitting a rearrangement of the volume of the cystic mass enabling it to be molded and forced back through the superior thoracic aperture by increased intrathoracic pressure. This appears to be indicated in Figure 3 by the lateral bulge of the mass above the first rib, which forms the lateral margin of the constricting superior thoracic strait.

Wakeley and Mulvany state that *goitre plongeant* is usually accompanied by much more subjective disturbance than the other varieties of intrathoracic goiter, particularly by what are called "choking spells," and is therefore more likely to produce a fatal result. The goiter may be expelled vigorously during an attack of coughing, vomiting, or even by swallowing. A choking spell may produce hemorrhage within the goiter, thereby causing it to enlarge further and become incarcerated within the thorax if it happens to be intrathoracic at the time.

The association of the pharyngo-esophageal diverticulum with the intrathoracic goiter is believed to be merely coincidental, although one may conjecture that the dysphagia induced by pressure of the mediastinal mass on the esophagus was a causative or contributory factor. Against this theory is the rarity of such association, no similar case having been observed or reported, and also the invariable occurrence of pharyngo-esophageal diverticulum without demonstrable cause.

SUMMARY

A case of *goitre plonegant*, or plunging goiter, in association with a pharyngo-esophageal diverticulum (presumably coincidental) is reported and illustrated by roentgenograms showing the goiter in its intrathoracic and intracervical positions.

The essential feature of the condition is the disappearance of a cervical goiter within the chest and its reappearance in the neck following a straining effort or during an attack of coughing.

Plunging goiter is of rare occurrence. It has been said to be accompanied, as a rule, by much more subjective disturbances than other varieties of intrathoracic goiter, particularly by so-called "choking spells," which may prove fatal.

The mechanics by which a thyroid adenoma descends into the superior mediastinum is described. With enlargement of the adenoma, displacement back into the neck by swallowing, coughing, or straining becomes more difficult, and finally the mass may become permanently incarcerated within the chest.

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SUMARIO

Goitre Plongeant Asociado a Divertículo Faringo-Esofágico. Presentación de un Caso

Un caso de *goitre plongeant* (bocio hundido), asociado a divertículo faringo-esofágico (presuntamente pura coincidencia) es descrito e ilustrado con radiografías que muestran el bocio en sus posiciones intratorácica e intracervical. La característica esencial del estado es la desaparición de un bocio cervical dentro del tórax y su reaparición en el cuello después de un esfuerzo intenso o durante un acceso de tos.

El *goitre plongeant* es raro. Se ha dicho que va acompañado, por regla general, de trastornos mucho más subjetivos que otras variedades de bocio intratorácico, y en particular de los llamados "ataques de asfixia," que pueden resultar letales.

Descríbese el mecanismo que hace descender un adenoma tiroideo al mediastino superior. Al crecer el adenoma, se vuelve más difícil el retrodesplazamiento al cuello por efecto de la deglución, la tos o el esfuerzo, y por fin la tumefacción queda permanentemente encarcelada en el tórax.

Protective Effect of Small Lead Shields During Repeated Whole-Body X-Ray Irradiation of Rats[1]

J. GERSHON-COHEN, M.D., M. B. HERMEL, M.D., and J. Q. GRIFFITH, Jr. M.D.

LEAD SHIELDING of the exteriorized spleen has been shown by Jacobson *et al.* (1) to decrease the lethal effects of whole-body x-ray irradiation. The experiments to be recorded here were done to determine the lethal effects of repeated whole-body irradiation with lead shielding of only small portions of the body of the rat.

Fig. 1. Rats in treatment compartments. A. Control. B. Liver shielded. C. Right lower abdomen shielded. D. Right lung shielded.

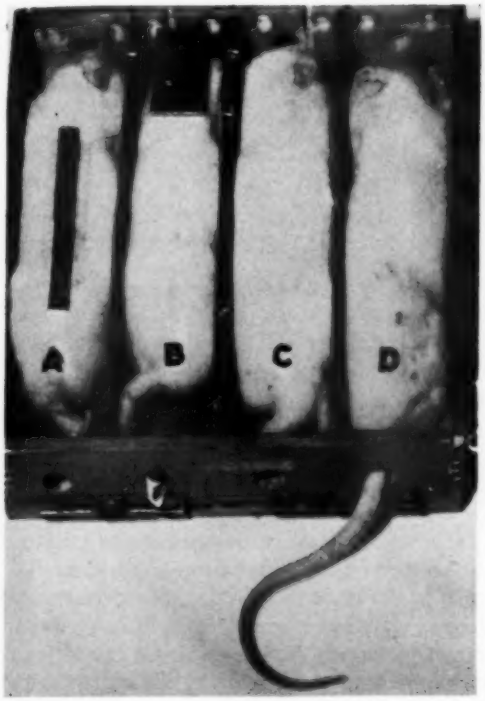

Fig. 2. Rats with lead shields over (A) dorsolumbar spine and (B) head. C. Controls. D. Tail outside field of irradiation.

METHOD

White female Wistar rats, 110 days of age, averaging 200 gm. in weight, were divided into 9 groups of 10 each. The x-ray factors used for whole-body irradiation were 200 kv., 25 ma., 0.5 mm. Cu + 1.0 mm. Al filter, 50 cm. distance, 4 minutes 40 seconds exposure, for a total LD 50 of 600 r. The half-value layer equaled 1.1 mm. of Cu. Each rat was placed in a close-fitting compartment of a cigar-box frame, the cover of which was a thin transparent acetate sheet. The lead shields, 1/8 inch thick, were fixed to this cover over various parts of the body (see Figs. 1 and 2). Small portions of contiguous structures around each organ received some transient protection from the lead shields because of slight unavoidable movement of the unanesthetized rat. In Group III the lead shields were placed over the tails of the animals, in Group IV over the heads, in Group V over the dorsolumbar spine, in Group VI over the liver, in

[1] From the Department of Radiology, Jewish Hospital, Philadelphia, Penna. Supported in part from the Louis Sitnek Fund, Eagleville Sanatorium, Eagleville, Penna. Accepted for publication in August 1951.

TABLE I: SURVIVAL RATES

Group	Irradiation	No. of Rats	After First 600 r	No. of Rats	After Second 600 r
I	None	10	...	..	...
II	Whole body	10	6 (60%)	6	6 (100%)
III	Tail shielded	10	10 (100%)	10	9 (90%)
IV	Head shielded	10	10 (100%)	10	9 (90%)
V	Spine shielded	10	10 (100%)	10	10 (100%)
VI	Liver shielded	10	10 (100%)	10	10 (100%)
VII	Rt. lower abdomen shielded	10	10 (100%)	10	5 (50%)
VIII	Right lung shielded	10	10 (100%)	10	10 (100%)
IX	Spleen shielded	..	..	9	9 (100%)

Group VII over the right lower abdomen, in Group VIII over the right lung, and in Group IX over the spleen. The shields over the liver and spleen were localized by fluoroscopic control. The rats in Group I were not irradiated, serving as controls, and the rats in Group II received whole-body irradiation without lead shielding of any part of the body.

The average daily weights, blood counts, bleeding and clot retraction times were determined for each group. These observations were continued for thirty days. Then, after an additional interval of four days, all rats were again subjected to similar whole-body irradiation with the same areas shielded, and the observations were repeated.

RESULTS

After the first exposure, all the rats in each group survived except for Group II, in which there were only 6 survivors (Table I). The rats in this group were subjected to whole-body irradiation without lead protection. Those which died showed evidence of bleeding, chiefly into and from the mucous membranes of the respiratory and gastro-intestinal tracts, but the bleeding time and clot retraction studies showed no abnormalities. These findings suggest that screening of small portions of the body with lead shields offers some protection against the lethal effects of whole-body x-ray irradiation. Similar findings have previously been reported by us (2).

Following the second dose of radiation the survivors of the first exposure still survived except for 1 animal in Group I, 1 in Group IV, and 5 in Group VII, in which lead shields were placed over the right lower abdomen. The death of the 5 Group VII animals was not anticipated, since the sensitive gastro-intestinal tract was partially shielded.

Weight determinations (Table II) after the original x-ray exposure revealed a transient loss during the first ten days. This was followed by a return to normal levels by the thirtieth day in the animals of all groups. Following the second dose of 600 r, loss of weight occurred in all groups. By the thirtieth day, many of the animals had regained the lost weight but had not acquired the additional weight normal for their increased age. Thus a general nutritional impairment was evident from this repeated exposure to whole-body irradiation in spite of the slight effect on the mortality rate.

The hemoglobin and red blood count (Table III) showed transient depressions in all groups, similar after both the first and second exposure to mid-lethal doses of x-ray radiation.

The average white blood cell counts (Table IV) decreased rapidly in all groups during the twenty-four hours immediately following the first x-ray exposure. This decrease became more marked within seventy-two hours, and the count remained low for ten days. Normal levels were ap-

TABLE II: AVERAGE WEIGHTS (GM.)

Group	Irradiation	Before Treatment	After First 600 r		Before Treatment	After Second 600 r	
			10 days	30 days		10 days	30 days
I	None	199	201	214	...	...	...
II	Whole body	194	197	213	213	194	212
III	Tail shielded	201	210	218	218	208	215
IV	Head shielded	204	213	221	221	207	222
V	Spine shielded	198	203	211	219	212	218
VI	Liver shielded	198	202	208	208	196	204
VII	Rt. lower abdomen shielded	196	192	206	211	200	210
VIII	Right lung shielded	201	200	211	210	201	211
IX	Spleen shielded	...	...	...	213	207	222

TABLE III: AVERAGE HEMOGLOBIN AND RED BLOOD CELLS

Group	Irradiation	Before Treatment		After First 600 r				Before Treatment		After Second 600 r			
				10 days		30 days				10 days		30 days	
		Hgb*	RBC†	Hgb	RBC	Hgb	RBC	Hgb	RBC	Hgb	RBC	Hgb	RBC
I	None	13.5	8,400	13.9	8,200	14.3	8,600	..	..	..	..	..	...
II	Whole body	12.5	7,300	11.5	6,900	14.2	8,800	14.1	8,700	12.4	7,600	13.8	7,600
III	Tail shielded	14.5	9,600	11.7	7,100	14.4	8,700	14.2	8,200	11.6	6,700	14.0	8,200
IV	Head shielded	14.4	9,200	11.4	7,400	13.4	8,600	13.8	8,300	13.2	8,100	14.1	8,500
V	Spine shielded	14.5	9,600	12.6	7,300	13.9	8,400	14.1	8,700	13.1	8,200	14.3	8,400
VI	Liver shielded	14.6	8,700	12.3	7,400	14.0	8,500	14.6	9,100	12.5	7,700	13.9	8,000
VII	Right lower abdomen shielded	14.2	8,800	13.2	8,100	13.9	8,500	14.2	8,800	13.0	7,800	13.7	8,200
VIII	Right lung shielded	13.5	8,600	13.3	8,000	13.2	8,400	13.5	8,100	13.2	7,600	14.4	8,100
IX	Spleen shielded	...	..	..	...	...	...	15.3	9,200	12.9	8,100	14.2	8,600

* Hgb. Equivalent gm./100 c.c.
† RBC. 000 omitted.

proached after thirty days. After the second exposure similar changes were observed, but normal levels were not attained until later.

The average percentage of polymorphonuclear cells (Table IV) showed a biphasic reaction. There was a noteworthy increase during the first three days, followed by a decline below normal levels by the thirtieth day in all groups. More prolonged elevation of the curve occurred during the two weeks following the second x-ray exposure, before normal levels were reached around the thirtieth day. This might have been due in part to the fact that the averages had not yet become stabilized at the time of the second exposure.

The average percentage of lymphocytes (Table IV) also went through biphasic changes after the first exposure, opposite in direction to the curve of averages for the polynuclear counts in all groups. After the second exposure the biphasic character of the curve was replaced by a single phase reaction in which the depression of the averages was prolonged through the thirtieth day.

DISCUSSION

The lead shields in these experiments were not used to confine single internal organs, as in the experiments of Jacob-

TABLE IV: WHITE BLOOD, POLYMORPHONUCLEAR AND LYMPHOCYTIC CELLS

Group	Irradiation	Before Treatment			After First 600 r												Before Treatment			After Second 600 r					
					24 hours			72 hours			10 days			30 days						10 days			30 days		
		WBC	P	L	WBC	P	L	WBC	P	L	WBC	P	L	WBC	P	L	WBC	P	L	WBC	P	L	WBC	P	L
I	None	9,800	39	52	...	..	..	...	..	..	...	..	..	9,200	40	54	...	..	..	..	..	..	...	..	..
II	Whole body	12,400	36	55	6,500	76	19	2,100	65	31	2,000	31	64	8,600	30	64	10,000	33	62	2,100	18	76	4,900	38	58
III	Tail shielded	11,200	28	69	3,600	78	17	1,200	67	29	3,200	34	58	7,000	41	54	6,400	36	59	800	42	53	5,200	50	44
IV	Head shielded	9,200	32	68	2,900	75	21	1,100	62	33	1,600	26	63	6,100	37	58	8,400	31	61	2,800	50	45	8,000	33	62
V	Spine shielded	8,800	44	50	3,600	72	25	800	63	32	5,500	33	62	5,500	34	60	10,500	22	71	1,050	51	44	6,200	48	46
VI	Liver shielded	11,000	47	44	2,400	62	34	1,500	80	12	1,900	23	72	8,400	40	55	11,200	13	83	1,900	27	68	6,600	31	63
VII	Right lower abdomen shielded	7,600	43	48	1,900	65	31	1,400	78	18	2,000	27	68	5,700	29	66	10,500	16	77	2,100	39	56	6,700	33	62
VIII	Right lung shielded	9,800	52	59	2,600	63	32	2,000	67	29	2,100	24	70	7,700	30	64	8,900	27	66	1,400	30	66	5,300	42	55
IX	Spleen shielded	...	..	..	...	..	..	...	..	..	...	..	..	...	..	..	14,400	29	66	3,300	24	67	7,200	38	57

son *et al.* (3), but included the overlying soft and bony structures. Thus, portions of the hematopoietic system were shielded as well as the various organs. It is difficult to correlate our findings with Jacobson *et al.* not only because of the difference in the method of shielding, but also because of the difference in the radiation dose. There is, however, some agreement in the observations that lead shielding of small surfaces of the body, averaging 15 per cent in our series, affords a measure of protection against whole-body x-ray irradiation. Possibly it requires relatively little protected hematopoietic tissue to increase the resistance of an animal against the short-term lethal effects of roentgen rays, even when the exposure is repeated.

During these experiments, platelet determinations were made, but not detailed. The findings were not as constant as those reported by Allen, Moulder, and Enerson (5). The cause for widespread bleeding observed just before the death of whole-body-irradiated animals is not well understood in spite of the numerous investigations of this subject, so amply summarized by Allen and his associates (6). Endothelial damage has long been suspected, and the work of Bigelow, Furth, Woods, and Storey (7) appears to fortify the suspicion that this is a factor in hemorrhage after LD 50 exposures of dogs and rats to x-ray irradiation. Cronkite *et al.* (8) conclude that the hemorrhagic state in animals which have received lethal doses of x-rays is not identical with any of the hemorrhagic diseases encountered in clinical medicine. They suspect the presence of a circulating anticoagulant in addition to the thrombocytopenia. At this time, it appears that much is yet to be learned concerning the disturbed mechanisms of the hematopoietic system following whole-body x-ray irradiation.

The high survival rate of rats after the second LD 50 exposure (600 r), except in one group, may be attributable to the size of the dose. The choice of 600 r as an LD 50 for female rats approximately 110 days old may not have been well advised. Abrams (4) found that the age at which mice are irradiated affects profoundly their resistance to a single exposure of whole-body irradiation. Mortality was high at thirty days of age and thereafter decreased rapidly with increasing age. At the beginning of the second exposure, our rats were 144 days old as compared to 110 days for the first experiment. This small difference in age would not seem significant as a factor in the LD 50.

Cronkite *et al.* (9) have recently reported increased tolerance of mice to lethal x-radiation following previous sublethal exposures. Their sublethal doses of 144 r were given at weekly intervals for three weeks. Thirty days after the third weekly dose, a lethal dose of 703 r was given. The mortality rate of 26 per cent in this group compared with 41 per cent in a group which received the same dose without the preliminary sublethal doses indicates, as do our experiments, an increased resistance to the subsequent lethal dose. Raper (10) also noted an increased resistance to surface beta radiation after sublethal cutaneous exposure to beta rays.

It might be remembered that these observations were all short-termed. Experience with the cumulative effects of x-radiation would suggest that, while animals may tolerate a relatively large x-ray exposure better after initial sublethal doses, delayed morbidity and shortened longevity may be expected.

SUMMARY

1. Small lead shields placed over various surfaces of the body were found to enhance the survival rate of rats exposed to whole-body x-irradiation. This occurred when the shields covered only 15 per cent of the exposed body surface.

2. A second dose of 600 r (LD 50) given thirty-four days after the first dose did not result in any significant decrease in survival rate, but disturbed nutrition, as evidenced by diminished weights, was slightly greater after the second exposure.

3. Transient slight reductions in hemo-

globin and red blood cells occurred after both the first and second LD 50 exposures.

4. After the first exposure, the white blood cell count dropped quickly within twenty-four hours, remaining low for ten days before it began to climb back to normal levels, which were reached about the thirtieth day. Following the second exposure, normal levels were not yet attained after thirty days.

5. After both the first and second exposures, the polymorphonuclear counts rose much above normal and then slowly returned to normal levels by the thirtieth day. These trends were not so uniform after the second exposure.

6. The lymphocyte counts dropped precipitously during the first twenty-four hours after exposure and tended to reach or exceed normal levels by the tenth day. A second exposure revealed similar trends, but normal levels had not yet been reached by the thirtieth day.

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SUMARIO

Efecto Protector de las Pantallitas de Plomo durante la Irradiación X Repetida de Todo el Cuerpo de las Ratas

Las pantallitas de plomo colocadas sobre varias zonas del cuerpo acrecentaron, según se observó, el coeficiente de sobrevivencia de las ratas expuestas a la irradiación X de todo el cuerpo. Esto sucedió aun cuando las pantallas no cubrían más de 15 por ciento del cuerpo.

Una segunda dosis de 600 r (DL50) administrada treinta y cuatro días después de la primera no dió por resultado mayor baja del coeficiente de sobrevivencia, pero, según demostró la pérdida de peso, la perturbación de la nutrición fué ligeramente mayor después de la segunda exposición.

Tanto después de la primera como de la segunda exposiciones a DL50 hubo leves y pasajeras bajas de la hemoglobina y los hematíes.

Después de la primera exposición, la fórmula leucocitaria descendió rápidamente en término de veinticuatro horas y continuó siendo baja por diez días antes de comenzar a subir nuevamente a cifras normales, que alcanzó hacia el trigésimo día. Después de la segunda exposición, a los treinta días no se habían alcanzado aun cifras normales.

Tanto después de la primera cuanto de la segunda exposición, las fórmulas polimorfonucleares se elevaron a mucho más de lo normal, volviendo después lentamente a lo normal para el trigésimo día. Esas tendencias no fueron tan uniformes después de la segunda exposición.

Las fórmulas linfocitarias descendieron precipitadamente durante las primeras

veinticuatro horas consecutivas a la exposición, tendiendo a alcanzar o superar tenores normales para el décimo día. La segunda exposición reveló tendencias semejantes, pero ni aun a los treinta días se habían alcanzado cifras normales.

Estos experimentos fueron llevados a cabo en 90 ratas divididas en nueve grupos compuestos de 10 animales cada uno. Un grupo no recibió irradiación, y en otro se irradió todo el cuerpo sin resguardo. En los demás grupos se aplicaron las pantallas sobre la zona del rabo, cabeza, raquis, hígado, porción derecha e inferior del abdomen, pulmón derecho y bazo, respectivamente.

Effective Thyroid Depth and Compensating Measurements for Iodine Uptake Determination[1]

ALLEN F. REID, Ph.D., and JEANETTE A. SORENSON, R.N.

THE USE OF radioactive iodine as a tracer in the determination of thyroid function is now well established. Each laboratory has its own preferred method of measurement, designed to show the fraction of an administered tracer dose which is taken up by the gland. In most instances, carrier-free I^{131} is the tracer and a Geiger counter is the measuring instrument, but otherwise the technic is far from standardized. In all cases the measured uptake is quantitatively dependent on the depth and distribution of thyroid tissue. This communication reports the results of the determination of the "effective depth" of glands in a sizable series, and the application of a routine procedure for making I^{131} uptake measurements on glands of widely varying depths.

In the measurements reported, a cylindrical gamma-ray Geiger-Müller tube was used; the technic is detailed later in the paper. To determine the effective depth of the gland, measurements were taken at skin-counter distances of 2.0 cm. and 15.3 cm. on 48 hyperthyroid and 77 euthyroid individuals, and the ratio was determined for each patient. A series of measurements was then made with a phantom bottle of I^{131} solution and the ratios determined between values for distances from 1.5 to 8.0 cm. and the corresponding values for distances greater by 13.3 cm. The "effective depth" for each thyroid corresponded to the difference between the phantom-counter distance and the skin-counter difference, which gave the same ratio of the long to the short measurement. The results are shown in Figure 1. From these data it can be seen that the "effective depth" varies widely from individual to individual, so that values based on an assumption of a standard

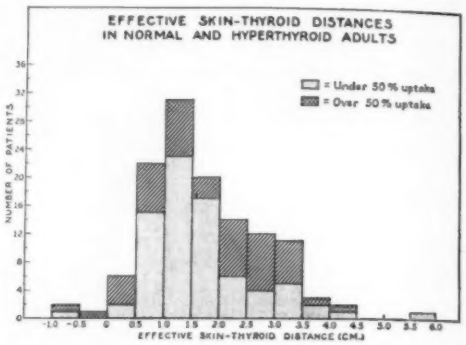

Figure 1

depth would more often than not be subject to at least a 10 per cent error and not infrequently to an error of over 40 per cent for counter-skin distances of 15 cm. Although this error may be reduced by measuring at greater distances, it cannot be eliminated, and larger doses of I^{131} or longer counting periods are necessary to compensate for the distance adjustment.

Of the many measurement technics employed, a few serve to illustrate the basic modifications. Hunt *et al.* (1) compare a measurement at 50 cm. from the patient (assumed skin distance) with a measurement of the test dose in the container. Jaffe (2) makes a similar comparison at a 10 cm. distance. Quimby (3) uses a tube at 15 cm. with a collimating shield admitting rays from a 15 × 10-cm. area of the patient and compares the measurement thus obtained with the measurement of a phantom of the same size and shape as the estimated gland. Luellen *et al.* (4) obtained measurements with a shielded tube centered 10 cm. from the thyroid gland and subtracted from it a similar measurement with a thick lead shield interposed between the counter tube and the gland. This gave counts

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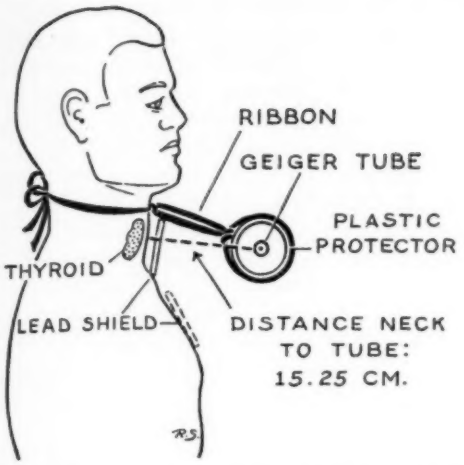

Fig. 2. Arrangement for counting I^{131} in the thyroid gland.

from the thyroid area. A correction was made for activity in the tissues of the neck other than the thyroid by subtracting 2.5 times the corrected counts 10 cm. above the left thigh. Keating *et al.* (5) used a similar technic in a special series and made measurements at both 25 cm. and 45 cm. from the center of the thyroid, using the inverse-square relationship to estimate the approximate effective point source of radiation and so determine the absolute quantity of radioiodine. This is similar in principle to the technic used in our measurements.

The method adopted as routine in our laboratories for measuring the radioiodine in a patient's thyroid gland comprises the following steps:

1. Find the anterior spot of maximum activity on the neck of the patient by passing a cylindrical gamma-ray tube up and down over the thyroid region.
2. Hold the counter horizontally and take a measurement [A] with the closest point of the counter tube 15.3 cm. from the patient's skin over the spot of maximum activity and with a 3/16-inch lead shield between the thyroid and the counter (Fig. 2).
3. Take a measurement [B] with the tube at the same position but the lead removed from the neck and placed at an equal distance from the counter to cover an equal area in the right thoracic region (Fig. 2).
4. Take a measurement [C] over the point of maximum activity with a 2.0 cm. skin-counter distance.
5. Take a measurement [D] 1.5 cm. from the thigh with the counter tube parallel to the extended thigh and its center 12 cm. from the hip joint.
6. Take a measurement [E] 16.5 cm. from the outside of a standard 2-oz. bottle (about 2 × 4 cm. base) containing a duplicate amount of I^{131} in 15 ml. of solution.
7. Take a background measurement [F].

When the measurements are corrected for resolving time, the following net values are calculated:

Far thyroid measurement = B − A
Close thyroid measurement = C − D
Phantom measurement = E − F

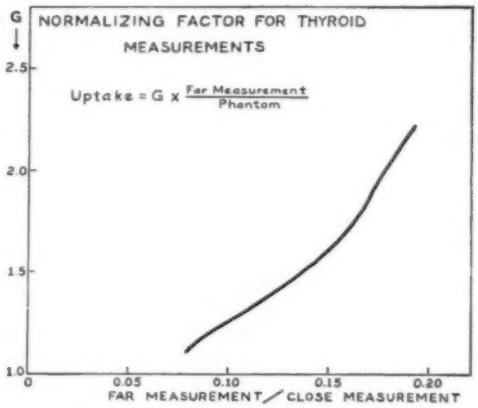

Fig. 3. Determination of I^{131} uptake from close and far Geiger counter measurements.

The ratio of the close and far measurements will vary, depending on how far the glandular tissue is from the spot of maximum activity on the skin. A difference in that distance will cause a difference in counting rate for the same I^{131} activity, not only because of change in geometrical efficiency but also because of differences in tissue absorption and scattering. Furthermore, the lead shield does not remove all the gamma-rays emitted from the area covered. All these effects, however, can be evaluated by simple calibration measurements and charted for convenient usage. Figure 3 shows such a chart used in these laboratories. From this chart a single factor, G, is obtained; and the fraction uptake is:

$$\text{Uptake} = G \times \frac{B - A}{E - F}$$

In general, adequate maintenance of the proper skin-counter distance may be secured by tying a ribbon around the patient's neck and around the counter. This simple expedient eliminates the need for elaborate preparation and restraint of the patient. When a sensitive gamma-ray counter is used, an oral dose of 15 to 25 microcuries of I^{131} will easily provide adequate activity in the thyroid for quick accurate measurements.

It is necessary to consider the suitability of the sample-bottle phantom. Its convenience is undeniable. On checking with a dummy neck it was found that the area distribution furnished to the counter by the bottle for a given effective depth was about as good for the measurements made as that obtained from painstakingly constructed dummy thyroids.

Finally, the reliability of the background corrections must be appraised. The position of the lead shield for the far measurement correction and the position of the counter for the close measurement correction were chosen from measurements on patients with no functioning cervical thyroid tissue. The data used were quite limited, and with further experience some modifications may be indicated. Any reasonable error from such a source, however, would have a relatively minor effect on the accuracy of the uptake determination. In any event, the insertion of a lead shield in front of the thyroid to get a background measurement is a better technic for measurements at a distance than counting a particular body area, since the distribution of body I^{131} per unit area varies widely with individuals, *e.g.*, it is necessarily concentrated in a much smaller area in children.

Assuming that a sufficient number of counts are taken at each measurement so that the statistical counting error is relatively small, the over-all error of uptake measurements made routinely by the method detailed is probably less than 7 per cent of the uptake value. This is sufficiently small for most purposes.

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SUMARIO

Mediciones Efectivas y Compensadoras de la Profundidad del Tiroides para la Determinación de la Absorción de Yodo

Visto que la absorción medida de yodo radioactivo por el tiroides depende cualitativamente de la profundidad y distribución del tejido tiroideo, los AA. determinaron la "profundidad efectiva" de dicha glándula en una serie de 125 personas, observando que variaba notablemente de persona en persona.

Ofrécese un método para la medición de la absorción en glándulas de profundidad muy distinta, con el cual el error parece ser de menos de 7 por ciento.

Air-Contrast Study of the Duodenal Bulb[1]

Its Importance in the Diagnosis of Duodenal Ulcer

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TEMPLETON, Marcovich, and Heinz (1) stated that the only reliable x-ray evidence for *active* duodenal ulcer is the ulcer niche or crater, and they described the compression technic for its demonstration. By means of fluoroscopy and spot films of outstanding quality, they were able to demonstrate a crater in a high percentage of cases regarded as active on careful clinical study. Most craters occurred on the anterior or posterior wall remote from the greater or lesser curvatures, where they would be obscured by barium unless effective compression could be applied.

In some patients, particularly of the sthenic type, the duodenal bulb will lie high beneath the ribs or in a posterior position where it cannot be compressed. Occasionally, also, marked abdominal muscle guarding will prevent effective compression. Sosman (2) said that he was unable to compress the bulb in 15 to 20 per cent of the patients whom he examined.

Craters may sometimes be recognized following evacuation of the bulb by peristalsis, but such recognition is infrequent. Less than one-fifth of all the craters which we detected by compression were also visualized during peristalsis. We found it difficult to be certain of craters if forced to rely on peristaltic evacuation alone.

A profile view of the duodenal bulb, obtained by turning the patient into a left anterior oblique position, will sometimes demonstrate a crater along the margin of the anterior or posterior wall. This maneuver, however, is not usually successful, for bulbs located high beneath the ribs are for the most part directed posteriorly and will be concealed by the overlapping barium-filled antrum.

Hampton (3) was the first to describe the

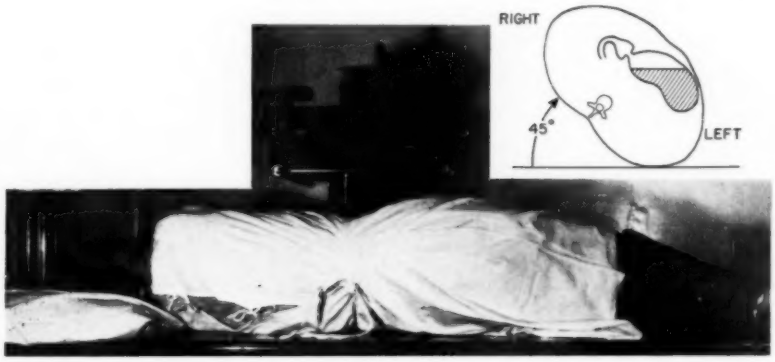


Fig. 1. Usual position of the patient during an air-contrast study of the duodenal bulb. The patient is lying in a 45° oblique position, the right side off the table. In actual practice, the degree of obliquity depends on the anatomical position of the bulb. A bulb which lies in the sagittal plane requires a high oblique or lateral position; one mainly in the transverse plane, a slight oblique.

The drawing at the upper right is a diagrammatic cross section through the abdomen as seen from below, showing the distribution of barium (shaded area) and air (unshaded area) in the stomach and duodenal bulb when the patient is in the position illustrated.

[1] From the X-Ray Department of Holy Cross Hospital, Salt Lake City, Utah. Accepted for publication in July 1951.

Fig. 2. Air-contrast study of the normal duodenal bulb. An adequate air study of the bulb requires technically good spot films free of motion and well exposed, a bulb projected free of the stomach and of other portions of the barium-filled duodenum, and a bulb well distended with air, with only a thin coating of barium remaining on the mucosa.

technic for air-contrast study of the duodenal bulb, showing it to be a successful method of demonstrating an ulcer crater. He recommended it when compression of the bulb was to be avoided because of recent gross gastro-intestinal hemorrhage. Templeton (1) discovered craters by air-contrast study when the bulb was inaccessible to compression. He did not specify the number of craters revealed by this method.

TECHNIC OF AIR STUDY

Air-contrast study of the duodenal bulb is regularly performed following the routine examination in the upright position. After the bulb has been filled with barium and compression attempted, the patient is placed supine. In this position the air normally present in the gastric fundus will gravitate to the antral end of the stomach. The bulb fills with air when it is elevated above the level of the stomach by raising the patient's right side off the table (Fig. 1). The degree of obliquity depends on the position of the bulb. A high oblique or lateral position is necessary to outline a bulb directed posteriorly; a slight oblique will suffice when the bulb lies in the transverse plane. Air will usually fill the bulb in a few seconds, leaving a thin coating of barium on the mucosa (Fig. 2). When filling is not prompt, compression of the antrum with the gloved hand or having the patient lie on the left side for a minute may be helpful. Spot films are routinely made because fluoroscopic visualization of the air-filled bulb is poor.

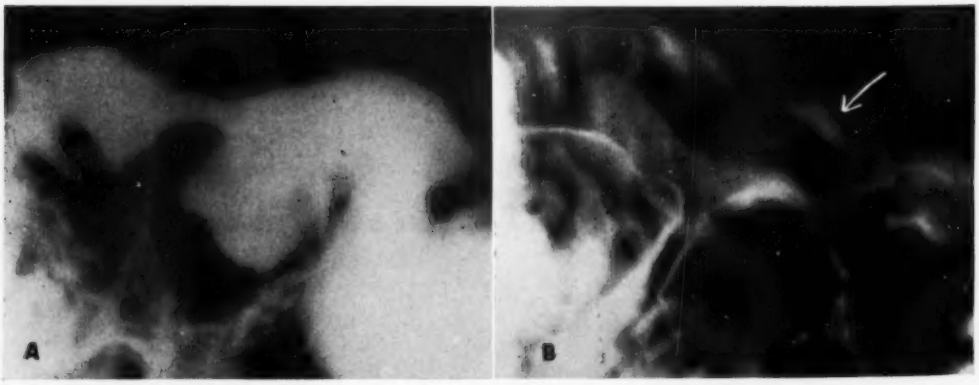
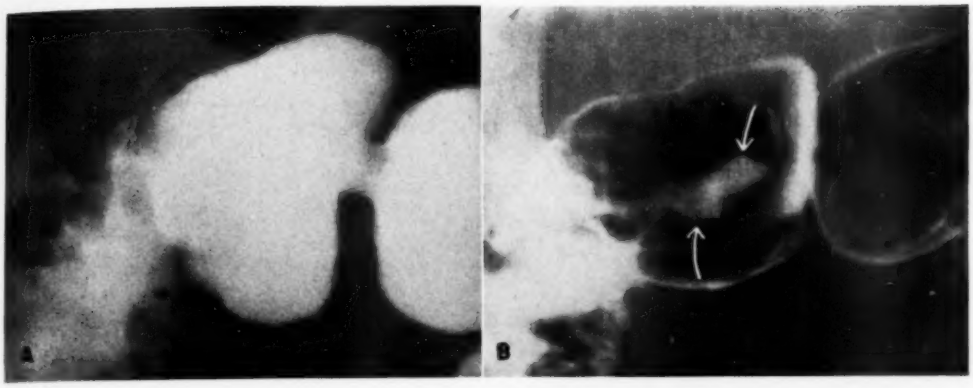


Fig. 3. Case I. A. The barium-filled, deformed duodenal bulb is sharply constricted in its mid portion. The bulb could not be effectively compressed because it was beneath the ribs and directed posteriorly.
B. Air-contrast study of the bulb, showing an oval crater (arrow). The fleck of barium was persistent in several views. The barium in the colon is residual from a previous upper gastro-intestinal series.



The evidence for crater formation, as obtained by air-contrast study, is the same as with compression. The barium fleck must be persistent in size, contour, and position. The crater is usually round or oval, occasionally slit-like. In some cases, where the evidence was questionable, we have repeated the examination. In such instances a crater was not diagnosed unless the barium fleck could be exactly reproduced.

Fig. 4. Case II. A. The undeformed barium-filled duodenal bulb. The bulb could not be palpated or compressed because of its high posterior position; it could be adequately demonstrated only in a true lateral position.

B. Air-contrast study of the bulb showing two ulcer craters (arrows).

C. Air-contrast study of the bulb taken six months later, when the patient was asymptomatic. The duodenal bulb is normal in contour and there is no evidence of a crater.

ANALYSIS OF DATA

The present analysis is based on 1,006 consecutive adult upper gastro-intestinal series. Diagnoses were made from a combination of fluoroscopy, routine spot films, and large films of the gastric region. All patients were examined in the upright and recumbent positions. Lesions visualized fluoroscopically were reproduced on films before a diagnosis was made.

TABLE I: AIR STUDY OF THE DUODENAL BULB IN 543 OF 1,006 CONSECUTIVE UPPER GASTRO-INTESTINAL SERIES (961 PATIENTS)

Compression adequate	758 cases
Air study adequate	231
Air study inadequate	82
Air study not done	445
Compression inadequate	248 cases
Air study adequate	150
Air study inadequate	80
Air study not done	18

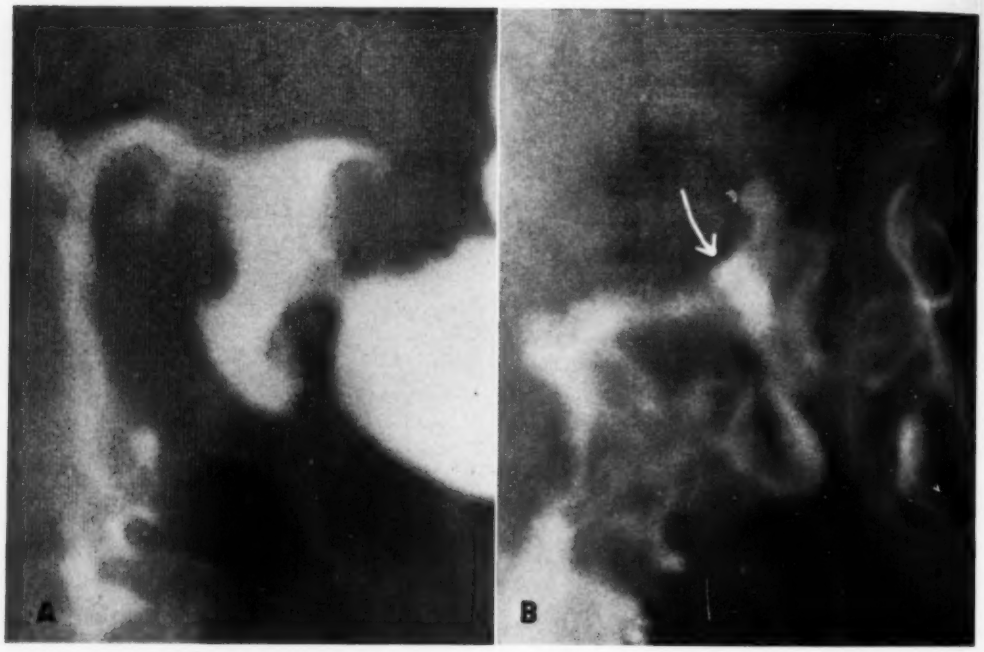
Compression of the bulb was unsatisfactory in 248 or 25 per cent of the cases (Table I), in nearly every instance because it lay high beneath the ribs.

Air study of the bulb was attempted 543 times; it was successful in 381 instances (70 per cent). Inadequate filling of the bulb with air was the usual reason for failure. A detailed analysis is given in Table I.

Duodenal ulcer was diagnosed 228 times in the 1,006 examinations. In 147, only a characteristic deformity of the bulb was found. The remaining 81 patients (35.5 per cent) had ulcer craters, 66 occurring in deformed bulbs, 15 in undeformed bulbs. The ulcer crater was detected by compression alone in 39 cases; in 35 cases it was

TABLE II: METHOD OF DETECTING DUODENAL ULCER CRATERS

		Compression Only		Air-Contrast Only		Compression and Air-Contrast
		Air-Contrast Attempted	Air-Contrast Not Attempted	Compression Adequate	Compression Inadequate	
Crater in deformed bulb	66	19	13	0	5	29
Crater in undeformed bulb	15	6	1	0	2	6
TOTAL	81	39		7		35



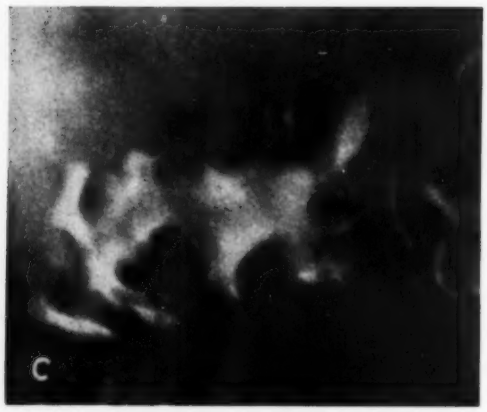
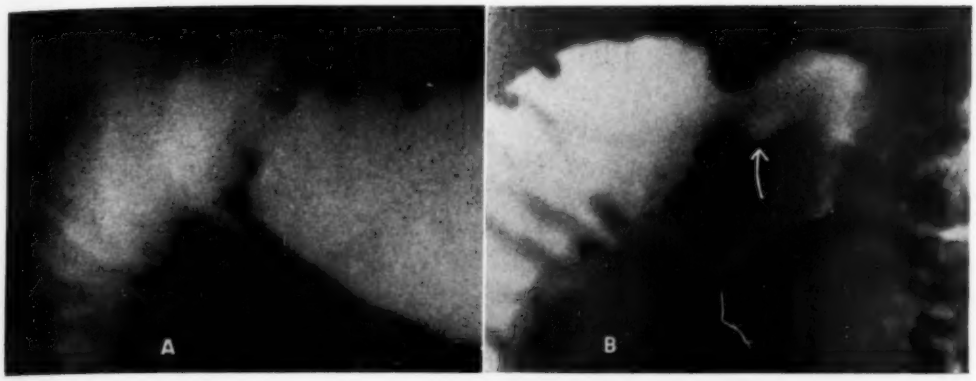


Fig. 5. Case III. A. The severely deformed barium-filled duodenal bulb lying high beneath the ribs, where it could not be compressed.
B. Air-contrast study of the bulb, showing an oval crater (arrow).
C. Air-contrast study of the bulb eight months later, when the patient was asymptomatic. Deformity of the duodenal bulb remains but there is no evidence of crater. The faint oval collections of barium in the bulb resembling craters were not persistent.

demonstrable both by compression and air contrast (Table II). In 7 patients in whom compression was inadequate, the ulcer crater was discovered only by air-contrast study. Two of these 7 patients had craters in undeformed bulbs, so that without air-contrast study the diagnosis of duodenal ulcer would not have been made. No attempt was made to correlate x-ray findings with clinical symptoms except when the crater was demonstrated only by air-contrast study. Brief reports of these cases follow.



CASE PRESENTATIONS

CASE I: R. J., male, age 59, had intermittent epigastric distress for fifteen years. An x-ray study four years before the present examination revealed "duodenal ulcer." Four weeks prior to examination, there had been an exacerbation of symptoms, with epigastric cramping pain two hours after meals and late at night, relieved by most foods but aggravated by uncooked vegetables and fried foods. An upper gastro-intestinal series revealed a deformed duodenal bulb which could not be compressed because it lay high beneath the ribs (Fig. 3A). Air-contrast study showed a small oval crater, 3 × 6 mm., in the mid portion of the bulb (Fig. 3B).

CASE II: E. H., male, age 50, had attacks of right upper quadrant and epigastric pain for three years, occurring fifteen minutes to one and one-half hours after meals and occasionally late at night, relieved by soda and food. Two weeks prior to examination he twice vomited coffee-ground material and passed several black, tarry stools. An upper gastro-intestinal series revealed a duodenal bulb normal in contour but too high beneath the ribs to be palpated (Fig. 4A). Two ulcer craters were visualized on air-contrast study, measuring 6 × 10 mm. and 8 × 11 mm. respectively (Fig. 4B).

The patient gradually improved on ulcer management. Six months later, after an asymptomatic period of six weeks, x-ray examination revealed a normal duodenal bulb. The craters could no longer be visualized on air study (Fig. 4C).

CASE III: W. L., male, age 43, had frequent episodes of anorexia, nausea, vomiting, and epigastric cramping pain, beginning two months before examination. Pain occurred two to three hours after meals and was relieved by food. An upper gastro-intestinal series revealed a severely deformed duodenal bulb which lay too high beneath the ribs to be compressed (Fig. 5A). Air-contrast study demonstrated a crater in the basal third of the bulb, measuring 5 × 8 mm. (Fig. 5B).

Ulcer management promptly relieved the symptoms. Eight months later an upper gastro-intestinal series showed a persistent deformity of the duodenal bulb, but no crater was demonstrable by air-contrast study (Fig. 5C).

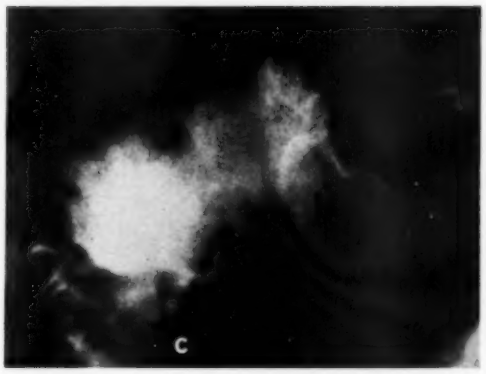


Fig. 6. Case IV. A. Minimal deformity of the barium-filled duodenal bulb (notch-like deformity of the superior border near the mid portion). Compression was ineffective.
B. Air-contrast study showing the deformity and a crater in the mid portion of the bulb (arrow)
C. Air-contrast study of the bulb taken five months later, when the patient was asymptomatic. There is no evidence of crater.

CASE IV: W. F., male, age 40, gave a history of attacks of epigastric soreness, heartburn, and "sour stomach" one hour after meals for two years. All symptoms but the epigastric soreness were relieved by food and soda. Gastric analysis showed a moderate hyperacidity. An upper gastro-intestinal series after an exacerbation of symptoms revealed minimal deformity of the bulb (Fig. 6A), which was too high beneath the ribs for compression. Air-contrast study demonstrated a crater 5 mm. in diameter in the mid portion of the bulb (Fig. 6B).

Symptoms were promptly relieved by ulcer management. Examination five months later, during an asymptomatic period, revealed a bulb normal in

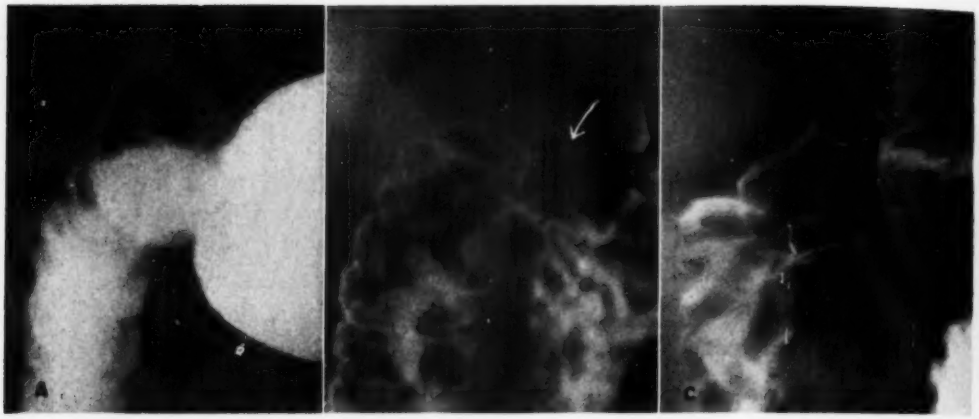


Fig. 7. Case V. A. The barium-filled duodenal bulb. The bulb was far posterior, high in the abdomen, and inaccessible to compression. The minimal deformity is not well shown even in this true lateral position.
B. Air-contrast study of the duodenal bulb clearly demonstrating the minimal deformity and a small oval crater (arrow).
C. Air-contrast study of the bulb ten months later, when the patient was asymptomatic. The deformity of the duodenal bulb and the crater have disappeared.

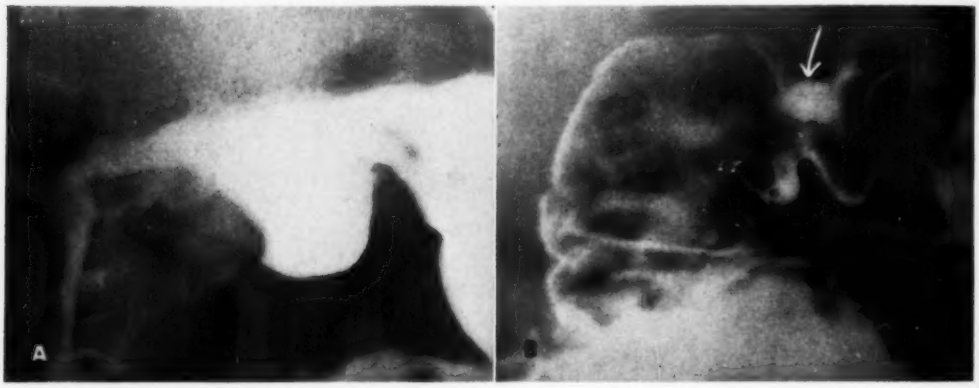


Fig. 8. Case VI. A. The deformed barium-filled duodenal bulb too high beneath the ribs for compression. B. Air-contrast study showing the deformity and an oval crater in the mid portion of the bulb (arrow).

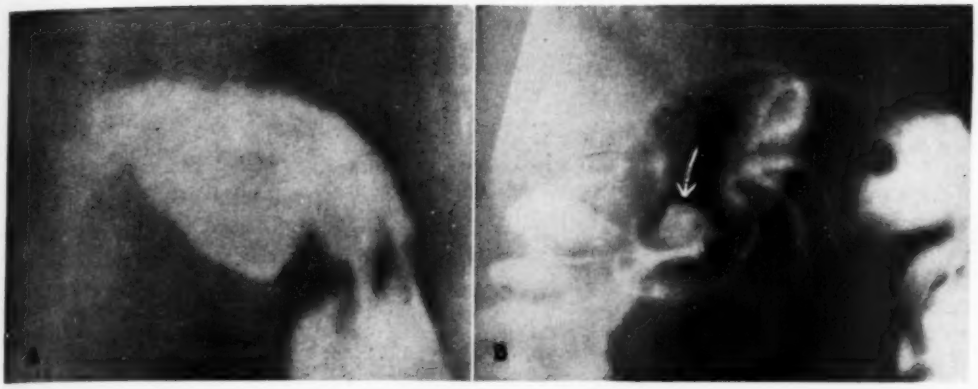
contour. No crater was visualized by air-contrast study (Fig. 6C).

CASE V: H. M., male, age 44, had attacks of epigastric pain for five years, occurring at night and three hours after meals, relieved by food and soda. Following a one month recurrence of symptoms, he passed two tarry stools and vomited dark blood. Gastric analysis revealed a pronounced hyperchlorhydria. A rapidly progressive anemia required correction by blood transfusions.

An upper gastro-intestinal series one week after the hemorrhage revealed a slightly deformed duodenal bulb high and directed posteriorly so that it could not be compressed (Fig. 7A). Air-contrast study outlined an oval crater, 4 × 6 mm. (Fig. 7B).

The patient responded well to supportive measures and an ulcer regime. He was discharged from the hospital asymptomatic eleven days after admission. X-ray examination ten months later, after a prolonged asymptomatic period, revealed an undeformed duodenal bulb, with no evidence of crater on air-contrast study (Fig. 7C).

CASE VI: J. M., male, age 50, had intermittent epigastric gaseous distress two to three hours after meals for one year. It was relieved by food and aggravated by spices. After one month of persistent symptoms, an upper gastro-intestinal series revealed an ulcer deformity of the duodenal bulb (Fig. 8A). The bulb could not be palpated because it was high beneath the ribs and directed posteriorly. Air-contrast study revealed an oval crater measuring 7 × 10 mm. (Fig. 8B).



Dietary management controlled the symptoms. Two months after the diet was abandoned symptoms returned. Distress continued intermittently for three months, when hematemesis and melena suddenly developed. Since hemorrhage persisted under medical management, a partial gastric resection was performed. A small bleeding point was found in the mid portion of an undeformed duodenal bulb.

CASE VII: D. H., female, age 52, had heartburn, epigastric pain, and gaseous distress for six weeks, occurring thirty minutes to one hour after eating, relieved by food. Gastric acidity was normal. In an upper gastro-intestinal series, a duodenal bulb normal in contour was visualized, lying high beneath the ribs, where it could not be compressed (Fig. 9A). Air-contrast study demonstrated a round crater in the distal portion of the bulb, measuring 8 mm. in diameter (Fig. 9B).

Symptoms quickly subsided on ulcer management. Air-contrast study of the duodenal bulb two weeks later showed a decrease in the size of the crater (Fig. 9C).

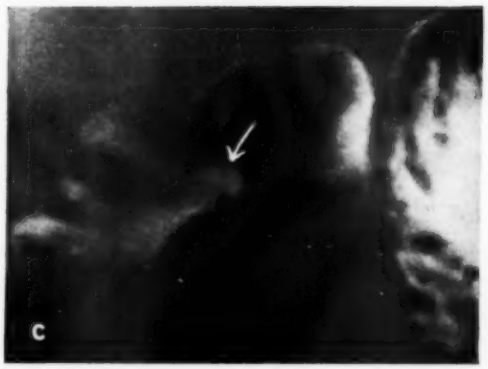


Fig. 9. Case VII. A. The barium-filled, undeformed duodenal bulb. Because of its position, it could not be effectively compressed.

B. Air contrast study of the bulb revealing a crater (arrow).

C. Air study of the bulb two weeks later, the patient having been asymptomatic since her first examination. The crater has decreased in size (arrow).

SUMMARY

1. The roentgen diagnosis of *active* duodenal ulcer depends on the demonstration of the ulcer crater.

2. The ulcer crater is usually detected by compression but the duodenal bulb may be inaccessible to adequate compression, as it was in 25 per cent of 1,006 upper gastro-intestinal studies.

3. When compression is inadequate, air-contrast study is essential for detecting the duodenal ulcer crater.

4. In seven of 81 cases of *active* duodenal ulcer, air-contrast study was the only means of visualizing the crater.

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ADDENDUM

Since this paper was written, 95 additional duodenal ulcers have been diagnosed. Craters were detected *only* by air-contrast study in 7 cases. In 5 patients the craters occurred in deformed bulbs; in 2 patients the bulbs were undeformed.

SUMARIO

El Estudio del Bulbo Duodenal con Contraste Aéreo: Su Importancia en el Diagnóstico de la Ulcera Duodenal

El diagnóstico roentgenológico de la úlcera duodenal activa depende del hallazgo del cráter de la misma. Suele distinguírsele con la ayuda de la compresión, pero el bulbo se mostró inaccesible a ésta en 25 por ciento de 1,006 estudios de la porción superior del tubo gastrointestinal. En esos casos, el estudio con contraste de aire resulta indispensable para revelar el cráter de la úlcera.

Comunícanse 7 casos en los que el contraste con aire ofreció el único medio de visualizar el cráter, formando los mismos parte de 81 casos de úlcera duodenal activa.

Después de llenar el bulbo con bario y de probar la compresión, colócase al enfermo en decúbito supino. En esa posición, el aire presente normalmente en el fondo del estómago gravitará hacia el extremo pilórico. El bulbo se llena de aire al elevarlo más arriba del nivel del estómago, lo cual se ejecuta alzando de la mesa el lado derecho del enfermo. Para demarcar un bulbo asestado hacia atrás, resulta necesaria una posición oblicua o lateral alta; pero basta con una oblicua ligera cuando el bulbo queda en el plano transversal. El aire llenará por lo general el bulbo en unos segundos, dejando una delgada capa de bario en la mucosa. Se toman radiografías instántaneas en la forma habitual, por ser inadecuada la visualización roentgenoscópica del bulbo lleno de aire.

Gallstone Impacted in the Duodenal Cap[1]

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BILIARY CALCULI discovered radiographically within the alimentary tube are usually located either at the duodenojejunal flexure or at the ileocecal junction (1, 3, 4). An infrequent site for impaction of a gallstone has been the duodenal cap. A number of instances of this occurrence have been recorded at surgery and autopsy (5, 6), but rarely has the condition been roentgenographically documented. Reports of only 4 cases with preoperative radiographic demonstration of a gallstone in the cap are available in the world literature (2, 5–7). So far as could be determined, none has heretofore been presented in the American literature.

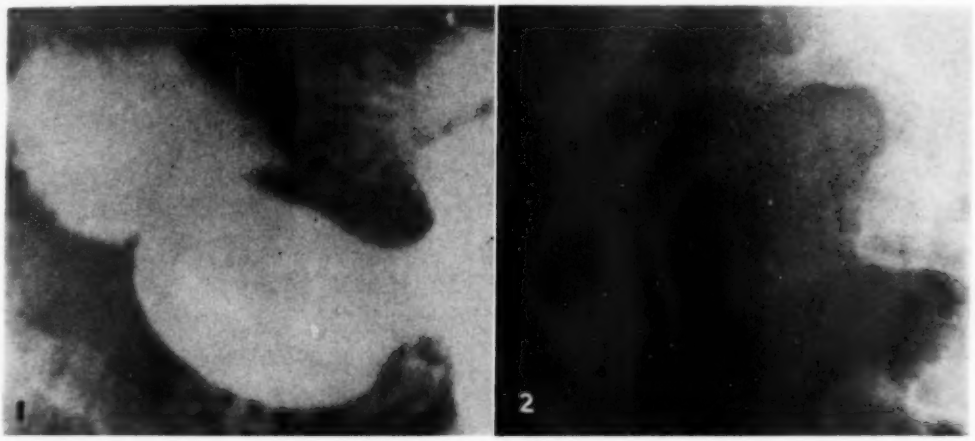

Fig. 1. Appearance of barium-filled antrum and duodenal cap at time of first admission, showing well outlined cap of normal shape and without defect.

Fig. 2. Finely calcified, oval outline in the soft tissues at the level of L-2 on the cholecystogram at the first admission, suggesting partially calcified gallstone in a non-functioning gallbladder.

CASE REPORT

T. K., a white, Russian-Jewish housewife, aged 50, was seen in the Emergency Room of the Henry Ford Hospital the evening of Nov. 11, 1949, complaining of the sudden onset that day of severe epigastric pain and the vomiting of food and "greenish material." This was the first such attack, although she had been troubled for some time by vaguely described upper abdominal distress and food intolerances.

The patient was in acute distress. There was no jaundice. Tenderness was noted in the right upper quadrant. For a week the temperature spiked daily to 102°. Blood counts revealed a polymorphonuclear leukocytosis, with some counts as high as 20,000. Antibiotic and supportive measures were followed by subsidence of fever and leukocytosis. Cholecystography, after priodax, showed no concentration of medium in the gallbladder. Roentgenograms and fluoroscopy revealed a normal stomach and duodenal cap (Fig. 1). The patient was discharged on Dec. 1, with the diagnosis of "subsided acute cholecystitis." Followed in the outpatient department, she had only minor complaints. Surgery was advised but repeatedly refused.

On the evening of May 13, 1951, the patient again presented herself at the Emergency Room, describing bouts of nausea and vomiting for a week. Again no jaundice was demonstrated and there was only slight upper abdominal tenderness. She was hospitalized and on May 17 passed, per rectum, a large, cholesterol gallstone measuring 2 cm. in diameter. Radiographic examination on May 18 showed a large speckled, oval, radiolucent defect, freely movable within the duodenal cap. Barium flowed past it

[1] From the Department of Radiology, the Henry Ford Hospital, Detroit, Mich. Accepted for publication in August 1951.

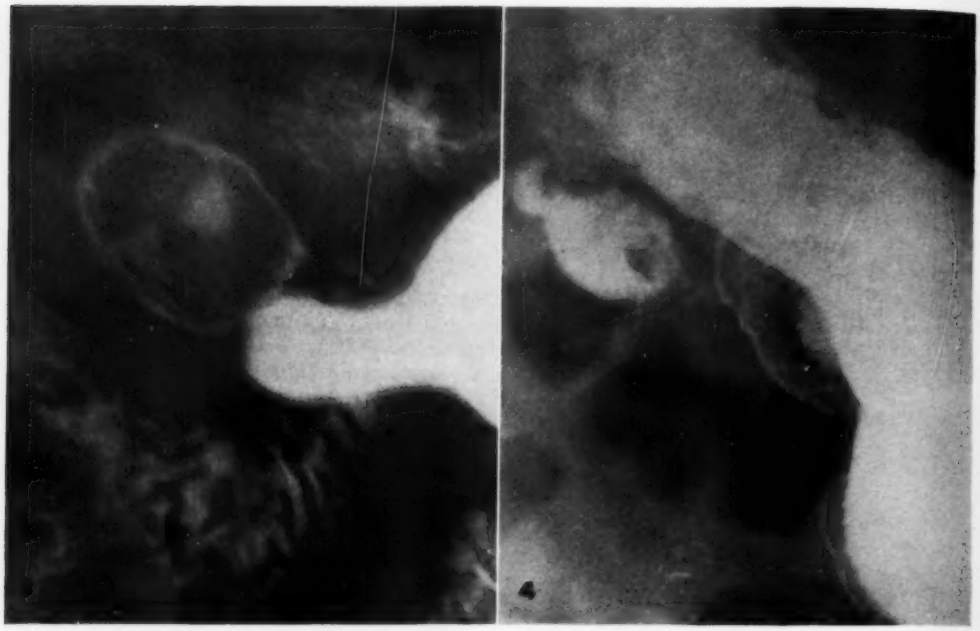

Fig. 3. Oval radiolucent filling defect occupying the duodenal cap, seen at the gastro-intestinal examination on the second admission. Barium has passed into the jejunum.

Fig. 4. Oblique projection showing the duodenal cap to lie behind the stomach shadow. Note the radiolucent defect representing the calculus. The fistulous tract to the gallbladder is outlined by barium. The gallbladder contains barium, is contracted and irregular, and shows small radiolucent shadows representing the smaller calculi found at operation.

into the descending portion of the duodenum. There was also a flow of barium through a short fistulous pathway into a small, irregular, contracted cavity in juxtaposition to the cap, presumed to be the gallbladder. This contained several small radiolucent shadows. The examination was repeated on May 23 and the findings duplicated. Review of the cholecystographic films of 1949, at this time, revealed a suggestion of calculus in the right upper quadrant (Fig. 2). In view of the known history of gallbladder disease, the passage per rectum of the calculus, and the obvious roentgen findings, a diagnosis was made of cholecystoduodenal fistula with calculus in the duodenal cap.

Surgical exploration was conducted on May 26 through the usual gallbladder approach. The gallbladder was found to be small, thickened, and adherent to the duodenal cap. The lumina of the two were continuous through a narrow passage, only large enough to accommodate a probe. The gallbladder was dissected free and removed. There was no stricture of the duodenum, which was partially mobilized and incised. A large pitted calculus was found lying free in the first portion and extracted. The duodenal incision was closed. One small calculus was adherent to the larger stone, and two were present in the gallbladder.

DISCUSSION

Cholecysto-enteric fistulae have been reported as occurring with varying degrees of frequency, by different authors with different sources of statistical material (3). The gallbladder may communicate with the duodenum, colon, stomach, jejunum, ileum, or portions of the urinary tract. By far the most common is communication with the duodenal cap. This is readily explained by the anatomical proximity of these organs and the frequency of their involvement in inflammatory changes. Following the onset of inflammation in either, a pericholecystitis and/or periduodenitis ensues, with subsequent formation of adhesions, which permit the erosive process that leads to fistula. Calculi, which cause either pressure necrosis or produce marked back-pressure by obstruction, are apparently necessary for the development of the fistula.

Fistulae, however, have been reported, surgically and roentgenologically, much more often than calculi in the bowel. The answer to this disparity, according to Borman and Rigler (3), lies in the ready passage of calculi through the biliary ducts and the bowel, including stones of rather large caliber. The stone passes but the fistula remains, to be demonstrated radiographically, by air or barium in the biliary tree, or at the operating table.

Fig. 5. Upright spot film demonstrating antrum, duodenal cap with calculus, fistulous tract, gallbladder, and second portion of the duodenum. Note heavier concentration of barium in the gallbladder.

It is plain that an intraluminal calculus may be retained at any point in the bowel if cicatrization or stricture formation occurs to narrow the caliber of a segment sufficiently. Apparently, in Andersen's case (2), and in the other three cited in the literature (5–7), no evidence of intrinsic stricture or scarring was manifest in the descending portion of the duodenum, nor was any found in the case reported here. In these instances, therefore, the nature of the mechanism of impaction of a calculus in the cap needs clarification.

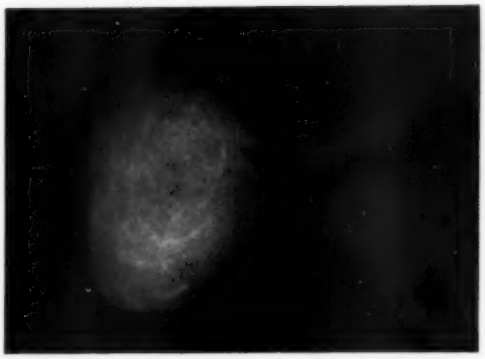

Fig. 6. Roentgenogram of large calculus removed from the duodenal cap at operation. A fair amount of calcification is evident.

We have indicated that a biliary calculus in the bowel lumen is usually found either at the duodenojejunal flexure or at the ileocecal junction. Certain common anatomical characteristics are evident at these loci. Both sites represent points of relative fixation and angulation in the course of the intestine. In addition, the ileocecal valve serves to narrow the caliber of the bowel at that point. These peculiarities dispose to impaction of an intraluminal object.

The fixation of the junction of the first and second portions of the duodenum by the posterior peritoneal attachment and the sharp angulation of the duodenum in this area would also appear to dispose to impaction of a calculus. The applicability of this mechanism must be questioned, however, because, in the face of this normal anatomical situation, there are so few reports of this occurrence. It is likely that some other factors are operative. Perhaps kinking caused by adhesions to the duodenum or compression by local tissue congestion might not be fully appreciated at surgery with the attendant disturbance of anatomical arrangements due to exposure and mobilization.

Filling defects in the duodenal cap may result from several causes. The differential diagnosis of these defects must take into consideration benign and malignant neoplasms (both of which are rare), pedunculated tumors of the stomach prolapsed through the pylorus, a foreign body or be-

zoar, aberrant pancreatic tissue, polyps, and calculus.

SUMMARY

1. A case is presented in which a large gallstone was discovered lying within the duodenal cap. This was well visualized radiographically, diagnosed preoperatively, and verified by laparotomy.

2. Only four cases, with radiographic illustration of this phenomenon, have been found in the world literature. As far as could be determined, this is the first case with radiographic diagnosis to appear in the American literature.

3. A short discussion of the clinical and radiologic manifestations is presented. Probable mechanisms of impaction are proposed.

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SUMARIO

Cálculo Biliar Encajado en el Bulbo Duodenal

En el caso presentado un cálculo biliar grande que yacía dentro del bulbo duodenal fué visualizado radiográficamente, diagnosticado preoperatoriamente y comprobado al ejecutar la laparotomía. No hay datos más que de cuatro casos en que se descubriera este fenómeno con los rayos X. Este parece ser el primer caso descrito en la literatura estadounidense.

Las fístulas entre la vesícula biliar y el bulbo duodenal no son raras, por virtud de la proximidad de dichos órganos y de quedar frecuentemente comprendidos en procesos inflamatorios. La menor incidencia de cálculos se imputa a que pasan fácilmente por las vías biliares y el intestino.

Parece que, a falta de estenosis por cicatrización, la fijación de la primera y segunda porciones del duodeno por la inserción peritoneal posterior y la aguda angulación del intestino en dicha zona pueden predisponer al encaje de un cálculo, aunque probablemente también intervienen otros factores, tales como acodadura debida a adherencias o compresión por congestión local de los tejidos.

Rhinolith

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In 1943, C. J. Polson made an exhaustive study of the literature, reviewing 384 cases of nasal concretions. He attributed to Mathias di Gardi (1502) the first report of a rhinolith, which, however, that writer had not seen. Bertholin, in 1564, was the first to record a case from personal observation. The rhinolith in this instance contained a cherry-stone nucleus.

The ages at which rhinoliths have been encountered range from three to seventy-six years, but the second and third decades are the periods of highest incidence. The greatest number of foreign bodies find their way into the nose during the first five years of life, and it is believed that two to four years elapse before complete incrustation takes place. The finding is more frequent in females. Seeligman observed that women blow their noses less frequently and more gently than men and are therefore less likely to remove foreign bodies. Snyder and Feldman believe that rhinoliths are less frequent in recent years than formerly because of the increased number of routine nasal examinations and corrections.

Only rarely are rhinoliths bilateral or multiple. Several small stones may be expelled at long intervals, but these are believed to be detached fragments of a single large stone. The stone most commonly rests on the floor of the nose or the inferior meatus, and enlargement is more often toward the septal than to the antral side, since the septum probably gives way more readily.

The size of the stones is variable. Dimensions are reported all the way from 9×6 mm. to 55×18 mm. The largest recorded rhinolith was the size of a hen's egg. The weights range from 0.3 to 110 gm.

The nuclei of these nasal concretions are classified as exogenous (false) and endogenous (true) types. A cherry stone inserted into the nose is a common exogenous nucleus. Polisar found an Indian nut in the rhinolith in one of his cases. Snyder and Feldman encountered a gauze sponge, a shoe button, and a piece of twine. Cunningham, Lord, Manley, and Polson reported a rhinolith with a nucleus of paper on which the printing was still legible. Nuclei of endogenous origin are represented by incrusted teeth, fragments of bone, blood clot, desquamated epithelium, and clumps of bacteria. Chemically rhinoliths consist chiefly of calcium phosphate. Other constituents are calcium carbonate, magnesium phosphate, organic matter, and water.

The foreign body is usually introduced into the nose through the anterior nares. Occasionally, as a result of vomiting, coughing, or sneezing, a cherry stone or some other food substance may lodge in the nose by way of the posterior nares. Polson believes that the foreign body produces mechanical obstruction which stimulates suppuration. Air currents in the nose concentrate the pus and remove from solution the salts, especially those of calcium. Precipitation and incrustation then occur on the surface of the nucleus.

There may be no symptoms for years, and the patient may forget completely about the entry of the foreign body into the nose. Sooner or later, a unilateral nasal discharge, which may be foul smelling and purulent, develops. Unilateral nasal obstruction is a common finding. Epistaxis, headaches, swelling of the nose, and conjunctivitis occur less often. Symptoms may be of short duration even though the foreign body has been present for years. Patients are known to have harbored rhinoliths as long as sixty years.

From the Department of Radiology, Gallinger Municipal Hospital, Washington, D. C. Accepted for publication in August 1951.

Complications are rare. There may be deviation, ulceration, and destruction of the nasal septum, antral wall, and palate. Rhinitis caseosa, sinusitis, and middle ear involvement may develop years after the formation of the rhinolith.

Rhinoliths should be differentiated from syphilis, calcified polyps, osteoma, osteomyelitis, and carcinoma.

Fig. 1. Left lateral view of the skull showing an irregular cauliflower mass, somewhat oval in shape, apparently united to the floor of the nasal cavity. The floor is intact. In this projection, the mass measures 6.5 × 5 cm. In the upper mid portion of the rhinolith there is a small curvilinear double density which may represent the nidus.

CASE REPORT

F. W. L., a 75-year-old white man, was admitted to the hospital on Feb. 17, 1951, complaining of intermittent substernal pain radiating down both arms over a period of nine months. The admission diagnosis was arteriosclerotic cardiovascular disease with moderate congestive failure, coronary insufficiency with possible myocardial infarction, and deformity of the left side of the nose. A hard swelling of the left side of the nose was an incidental finding.

The patient's condition was poor and a detailed history could not be obtained. He stated that when he was twenty-five years of age he had fallen to the ground, striking and injuring his nose, which became deformed and obstructed on the left side. The deformity increased slowly over the years and he was troubled with a chronic foul purulent drainage from that side of the nose. He suffered constantly from frontal headaches and pains in the left maxillary region. According to the patient, the only treatments he had received for his nasal ailments were local sprays.

External examination of the nose revealed a gross deformity with marked lateral displacement and firm swelling of the left side. On internal examination a large, grayish-brown, stony mass was seen completely obstructing the left nostril. This mass was firmly embedded, and a foul purulent discharge was noted around its edges. An attempt to move it caused severe pain.

Roentgen examination of the nose revealed a dense, irregular, calcific mass, non-homogeneous and coral-like in appearance, occupying almost the entire left nasal space. It extended from the anterior to the posterior nares inferiorly. The nasal septum was convex to the right.

A roentgenogram of the chest revealed a left hilar mass with circumscribed lateral border. It was felt that this mass probably represented a mediastinal tumor or carcinoma of the left lung. Pulmonary congestion, cardiomegaly, and arteriosclerotic changes of the aorta were also noted.

The patient died on March 21, 1951, in congestive failure. An autopsy was not done, but most of

the rhinolith was removed from the nose in fragments. The specimen was grayish-brown, calcareous, and coral-like in appearance. It was brittle and porous. Over its free surface was a foul, thick, mucopurulent secretion. A pathologist, after examining the specimen, reported that the nidus consisted of several fragments of a fruit stone, possibly that of a plum.

Fig. 2. Postero-anterior roentgenogram of skull showing an irregular dense shadow measuring 6.5 × 3.5 cm. occupying the left nasal cavity. The entire length of the nasal septum is deviated, with a convexity to the right. There are several disruptions in the continuity of the left lateral wall of the nasal cavity, which bulges markedly to the left.

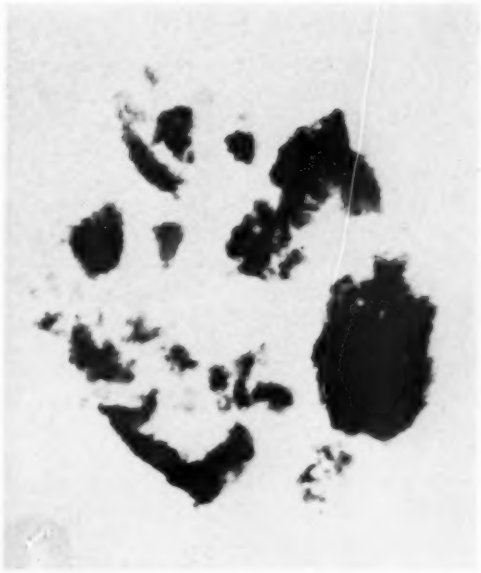

Fig. 3. Fragments of the rhinolith removed from the nose.

SUMMARY

A case of rhinolith in the left side of the nose is reported. This was an incidental finding in a patient admitted to the hospital because of arteriosclerotic cardiovascular disease associated with a mediastinal or bronchogenic carcinoma.

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SUMARIO

Rinolito

En un sujeto de setenta y cinco años, ingresado en el hospital por afección cardiovascular arterioesclerótica asociada a carcinoma mediastínico o broncógeno, se descubrió fortuitamente un rinolito grande en el lado izquierdo de la nariz. En la superficie aparecía en forma de edema duro, con deformidad de la nariz. Roentgenológicamente, era observable en forma de una espesa e irregular tumefacción calcificada, de aspecto no homogéneo y coralino, que ocupaba casi todo el espacio izquierdo de la nariz.

Los rinolitos tienen que ser diferenciados de la sifilis, los polipos calcificados, el osteoma, la osteomielitis y el carcinoma.

Encapsulated Pleural Effusion Simulating Mediastinal Tumor

Report of Two Cases[1]

CAPTAIN CLIFFORD F. STOREY (MC) USN.[2]

THE PURPOSE OF this report is to describe two cases of encapsulated paramediastinal pleural effusion which strongly simulated mediastinal tumors. In so far as it has been possible to determine, similar cases have not heretofore appeared in the literature. Since failure to recognize this condition might well lead to the performance of an unnecessary thoracotomy, it would appear important to add this disorder to the many others which must be considered in the differential diagnosis of apparent mediastinal masses.

CASE REPORTS

CASE I: S. S., a 38-year-old white man, was admitted to the U. S. Naval Hospital, St. Albans, N. Y., on Feb. 23, 1950, with a history of frequent attacks of mild precordial pain during the two years preceding admission. These attacks were precipitated by fatigue or excitement but not by exertion. The diagnosis of arterial hypertension had been made four years previously and the patient was receiving disability compensation for that disorder. His blood pressure was said to average about 190/120. There was no history of cardiac decompensation. Frequent attacks of headache and vertigo had occurred during the three or four years preceding the onset of his present illness.

Ten days before admission there had been a severe attack of precordial pain. The pain originated along the left border of the sternum in the region of the fifth anterior interspace and radiated to the left shoulder, down the left arm, to the fourth and fifth fingers of the left hand. The family physician, after making an examination and taking an electrocardiogram, told the patient that he had a "heart strain" and prescribed bed rest and mild sedation but the symptoms failed to subside. A slight nonproductive cough and a low-grade fever developed. Malaise and weakness became noteworthy and the patient sought hospitalization.

The patient had undergone yearly physical examinations because of hypertension and during the course of the routine study carried out ten days before the onset of his present illness a chest film had been taken. It was reported as negative.

Admission physical examination showed few remarkable findings. The blood pressure was 195/140. The heart was enlarged to the left. The aortic second sound was accentuated. There was dullness to percussion and breath sounds were absent over the left base posteriorly. No râles or friction rubs were heard. The right chest showed no abnormal findings. Both testes were atrophic.

A serologic test was negative and routine laboratory findings were within normal limits except for a leukocytosis of 17,200. The differential white blood count showed no significant departure from normal.

A postero-anterior chest roentgenogram (Fig. 1) showed a sharply circumscribed, smoothly marginated, rounded homogeneous area of increased density projecting to the left at the level of the pulmonary conus. Aneurysm of the left pulmonary artery was among the diagnostic possibilities prominently considered at that time. Stereoscopic frontal and left lateral films, however, showed the mass to be situated far anteriorly. In the lateral projection (Fig. 2) the mass appeared to lie immediately beneath the sternum at the level of the second anterior interspace.

Angiocardiography failed to show any connection between the mass and the heart or great vessels. A barium swallow revealed no deformity or displacement of the esophagus. Bronchoscopy was entirely negative. The bronchial aspirate stained by the method of Papanicolaou showed no abnormal cells. The tuberculin test was two plus in the weakest dilution. A Friedman test was negative.

For the week following admission, the temperature rose daily to 100° F.; it then fell to normal without antibiotics and there were no subsequent elevations. The total and differential white blood count became normal within ten days and remained so.

Chest films taken on April 7, 1950, (Fig. 3) showed a definite increase in the size of the mass. Thoracentesis yielded clear straw-colored fluid, which was negative on cytologic and bacteriologic study. Although they had been requested, pre-admission chest roentgenograms were not yet available for comparison, and the patient was scheduled for left exploratory thoracotomy. The tentative diagnosis was mediastinal tumor, type undetermined. Dermoid cyst was considered a likely possibility because of the extreme anterior position of the mass. Operation was planned for May 1, 1950, and because a

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The opinions or assertions expressed herein are those of the author and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

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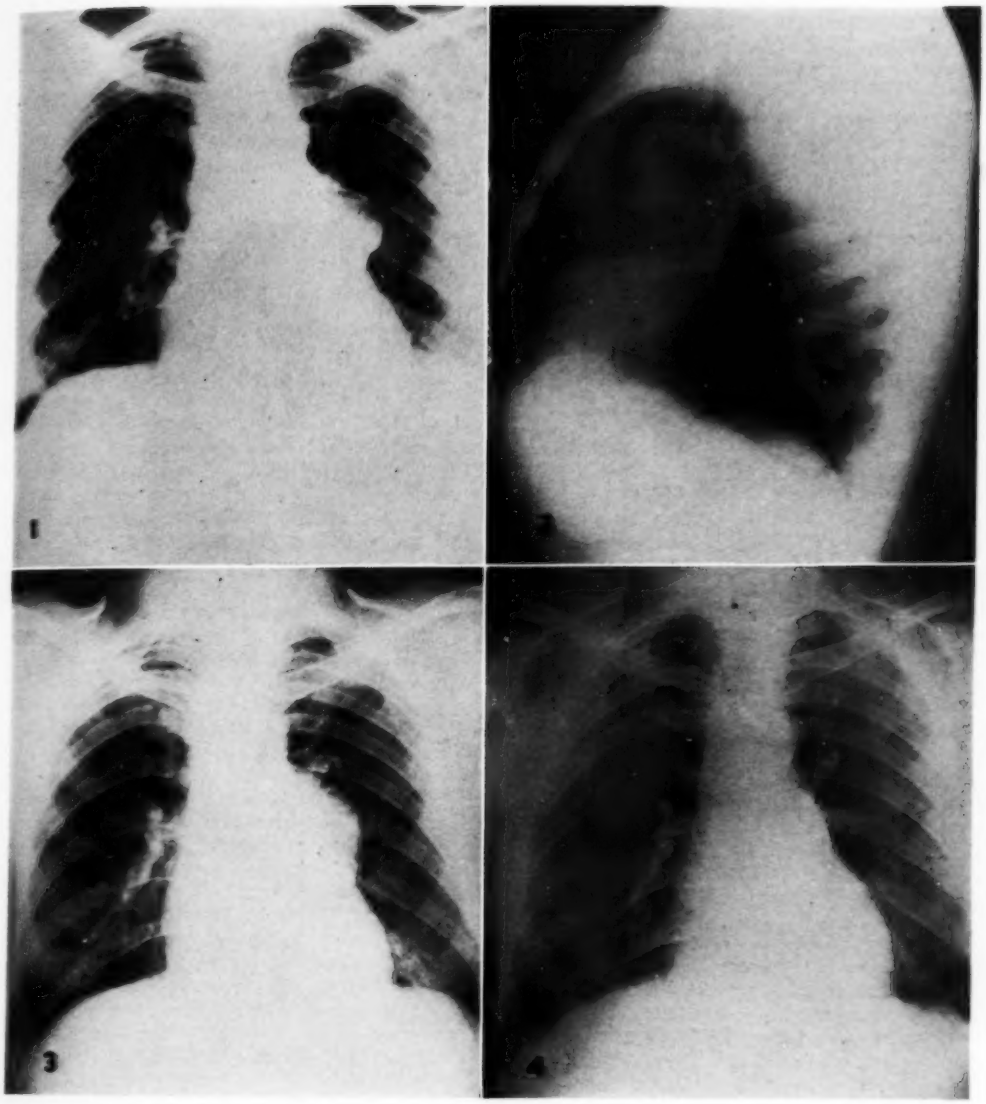


Figs. 1–4. Case I

Fig. 1. Postero-anterior chest roentgenogram taken in February 1950 shortly after admission, showing what appears to be a definite mediastinal mass on the left. There is a strong suggestion of calcification at the periphery of the mass.

Fig. 2. Left lateral chest film taken on April 7, 1950, when the mass had achieved its maximum size. Although it cannot be definitely identified in this view, it is believed to be situated far anteriorly at the level of the second intercostal space. The mass had been demonstrated also in an earlier lateral film (not suitable for reproduction).

Fig. 3. Postero-anterior film, April 7, 1950, showing the mass to have increased somewhat in size since admission. The presence of calcification in its "capsule" is no longer apparent.

Fig. 4. Chest film of May 1, 1950. Although the left costophrenic sulcus was not shown in this exposure, fluoroscopy revealed complete disappearance of the pleural fluid. Only a faint margin of the "tumor" can be seen overlying the cardiac silhouette in the region of the pulmonary conus.

recent chest film had not been obtained, fluoroscopy was performed the night prior to the contemplated surgery. The mass was then seen to have undergone a most remarkable regression. In the postero-anterior view it projected barely beyond the left heart border, and in the lateral and oblique positions it could not be identified. These findings were confirmed by films (Fig. 4) made the following morning. The proposed operation was cancelled and a further period of observation elected.

A few days later the chest films taken prior to admission to the hospital were obtained. The roentgenogram made on Feb. 1, 1950, (Fig. 5) showed no sign of a mass and no pleural effusion was present, while one taken on Feb. 23, 1950, (Fig. 6) showed the mass clearly. It had developed coincident with the onset of the present illness, the mass and the left pleural effusion appearing simultaneously.

Postero-anterior stereoscopic (Fig. 7) and left lateral (Fig. 8) chest films on May 12, 1950, showed no trace of the mass. The pleural effusion had completely resorbed and the costophrenic and cardiophrenic angles were clear. The patient was asymptomatic and afebrile, and all laboratory findings were within the limits of normal. Cultures of the sputum, bronchial aspirate, and pleural fluid remained negative for *M. tuberculosis*. He was discharged on May 24, 1950, with the diagnosis of pleural effusion, left, idiopathic. He has been seen on several occasions since that time and the chest films remain negative.

CASE II: E. A. M., a 19-year-old white man, was admitted to the U. S. Naval Hospital, Portsmouth, Va., on Dec. 5, 1948, because of hemoptysis. He gave a history of a chronic moderately productive cough of one year duration. The day preceding admission he had raised about three tablespoonfuls of bright red blood.

On physical examination few abnormal findings were recorded. There was slight dullness over the left apex, but no râles were heard. Normal values were obtained in routine laboratory studies. Postero-anterior tomograms showed a cavity, 1.5 cm. in diameter, in the left apex posteriorly. The sputum was positive for acid-fast bacilli on both smear and culture.

Repeated small hemoptyses continued for ten days following admission. On Dec. 15, 1948, streptomycin therapy, 1 gm. daily, was instituted. Two days later a left pneumothorax was instituted. Streptomycin was continued for forty-two days and a satisfactory pneumothorax was maintained for eleven months. Following its abandonment the lung re-expanded well. The sputum remained intermittently positive on culture but became negative on direct smear. In December 1949, a progressively increasing program of up time was begun. Shortly thereafter the patient was transferred to the U. S. Naval Hospital, St. Albans, N. Y.

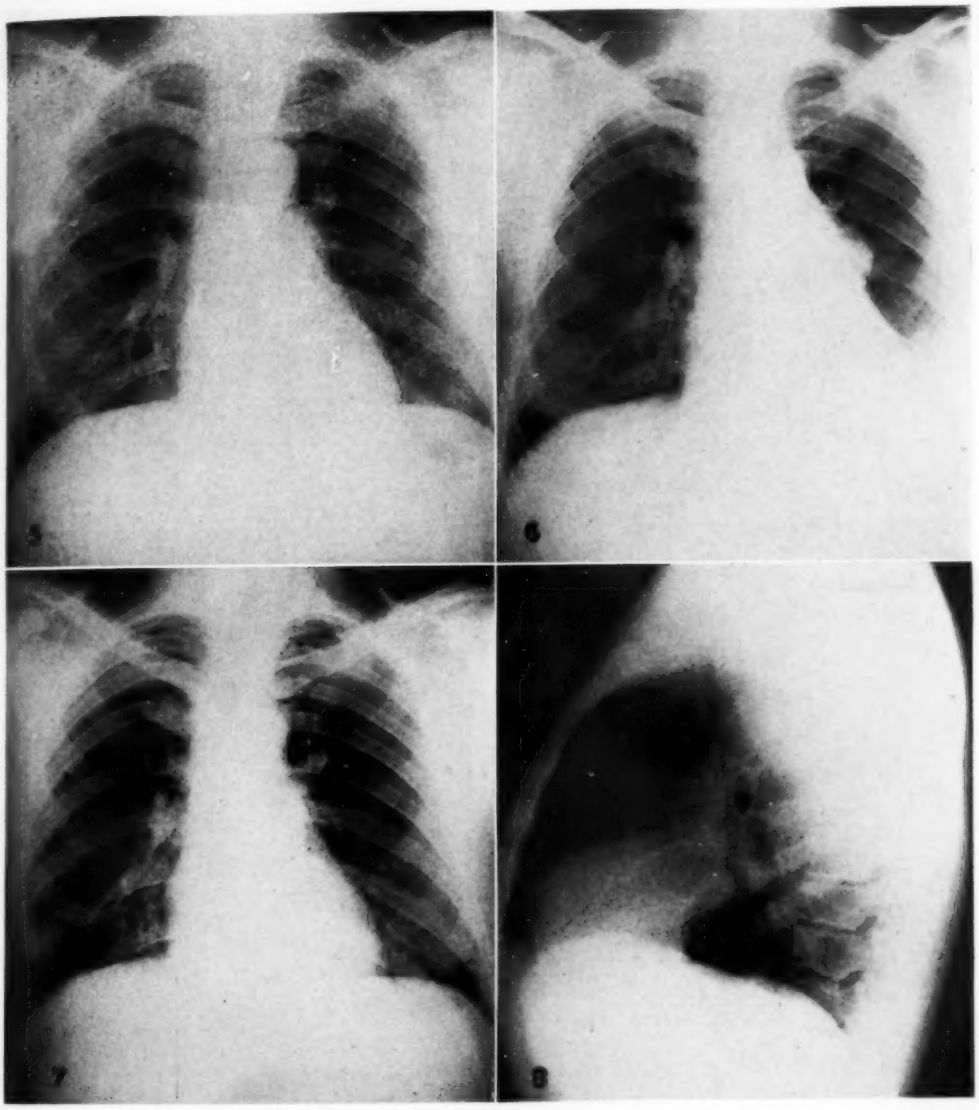
Chest roentgenograms (Fig. 9) made on admission at St. Albans showed the previously described tuberculous lesion in the left apex. No cavity could be defined in standard films. There was no evidence of a pleural effusion. Nothing suggestive of a mediastinal or paramediastinal mass was seen in these or any of the previous chest studies. Serial films made in March 1950 showed a small pleural effusion at the left base (Fig. 10). In the same roentgenograms a smoothly outlined, sharply circumscribed, homogeneous, rounded area of increased density was seen projecting to the left from the left cardiac border. The mass could not be clearly defined in the lateral films, but it was thought to lie anteriorly (Fig. 11) at the level of the fourth anterior interspace.

A large series of chest roentgenograms of this patient was available for comparison, examinations having been made at approximately monthly intervals since his admission to the sick list, covering a period of sixteen months. A review of these established the fact that there was nothing suggestive of a mass in the left cardiophrenic angle prior to the appearance of the left pleural effusion. The "mass" had suddenly appeared at the same time that fluid in the left chest was first seen. These facts led to the opinion that the apparent mediastinal mass most likely represented an encapsulated paramediastinal pleural effusion, and this impression, with the known presence of active pulmonary tuberculosis, led to the adoption of a conservative therapeutic program. Strict bed rest and streptomycin were resumed when the effusion appeared. Check-up films made one week later showed a slight increase both in the amount of the effusion and the size of the mass (Fig. 12). The patient was afebrile and remained so throughout the period of the effusion. Thoracentesis was performed on two occasions, 250 c.c. of fluid being obtained on the first chest tap and slightly less than 200 c.c. on the second occasion. The fluid was clear and straw-colored. It proved to be negative for *M. tuberculosis* on smear and culture.

Chest roentgenograms made one month later showed that most of the residual pleural fluid had been resorbed and the mass previously present along the left cardiac border was no longer visible (Figs. 13 and 14). The costophrenic angle remained slightly cloudy and the left hemidiaphragm was elevated and adherent to the chest wall anteriorly and laterally. Periodic fluoroscopic observation prior to its disappearance had shown a progressive diminution in the size of the mass as the effusion regressed.

A postero-anterior tomogram in October 1950 showed a persistent small cavity in the apical-posterior segment of the left upper lobe. The sputum remained intermittently positive on culture for *M. tuberculosis*.

On Oct. 31, 1950, a segmental resection of the apical-posterior segment of the left upper lobe was performed. The gross tuberculous disease was confined to that bronchopulmonary segment. A note-



Figs. 5–8. Case I

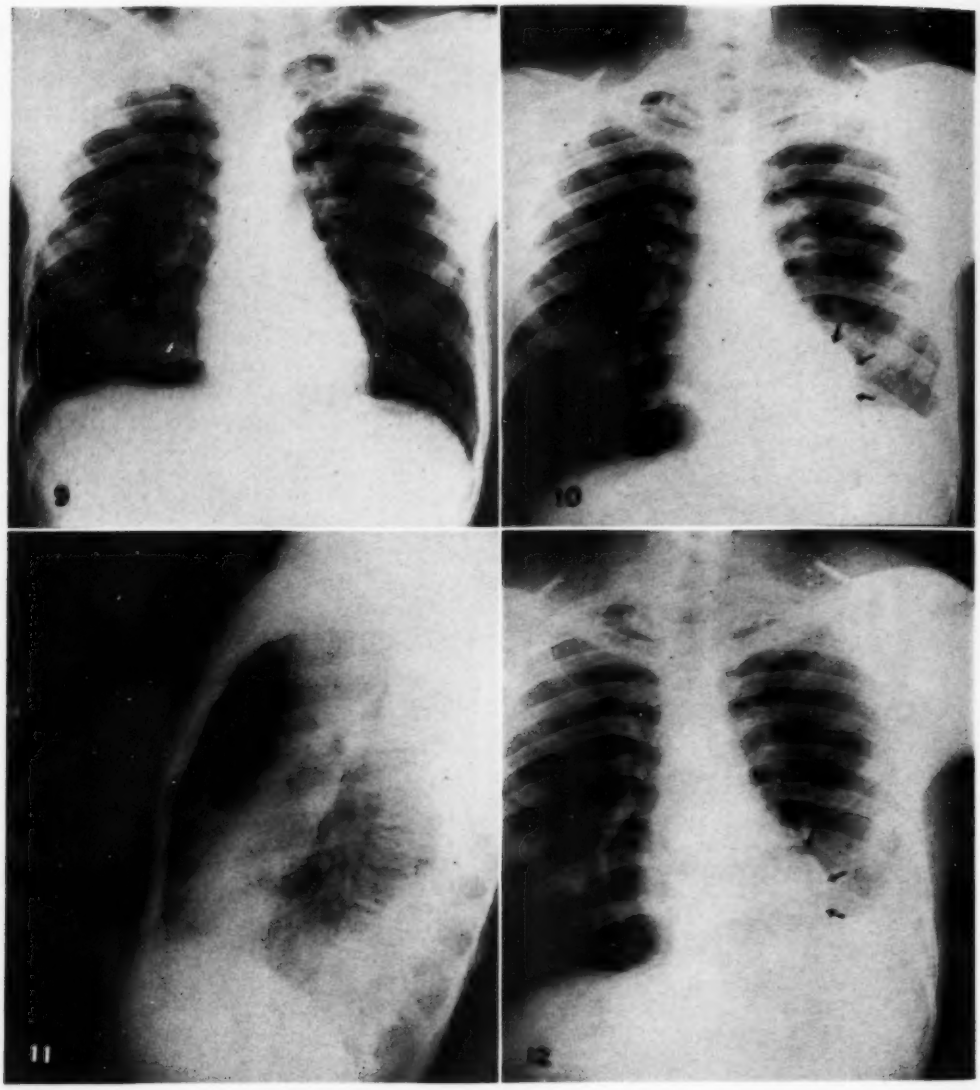
Fig. 5. Film made elsewhere, prior to the onset of the illness for which the patient was admitted, but not obtained for review until after those shown in the preceding figures had been made. This film, taken on Feb. 1, 1950, shows no pleural effusion and no suggestion of a mediastinal mass.

Fig. 6. Postero-anterior chest roentgenogram made on the day of admission, Feb. 23, 1950, showing a left pleural effusion and an apparent left mediastinal tumor.

Fig. 7. Postero-anterior chest film of May 12, 1950. There is nothing suggestive of a pleural effusion and no trace of the left mediastinal mass can be seen.

Fig. 8. Lateral view, May 12, 1950. The density noted substernally at the level of the second anterior interspace can no longer be seen. Compare with Figure 2.

worthy finding at operation was the presence of several broad bands of thin, easily divided adhesions extending from the lingula and medial aspect of the left lower lobe to the left anterior mediastinum, attached principally to the pericardium. It appeared clearly evident that these adhesive bands could well have afforded the site for loculation of pleural fluid at the time of the effusion. Nothing



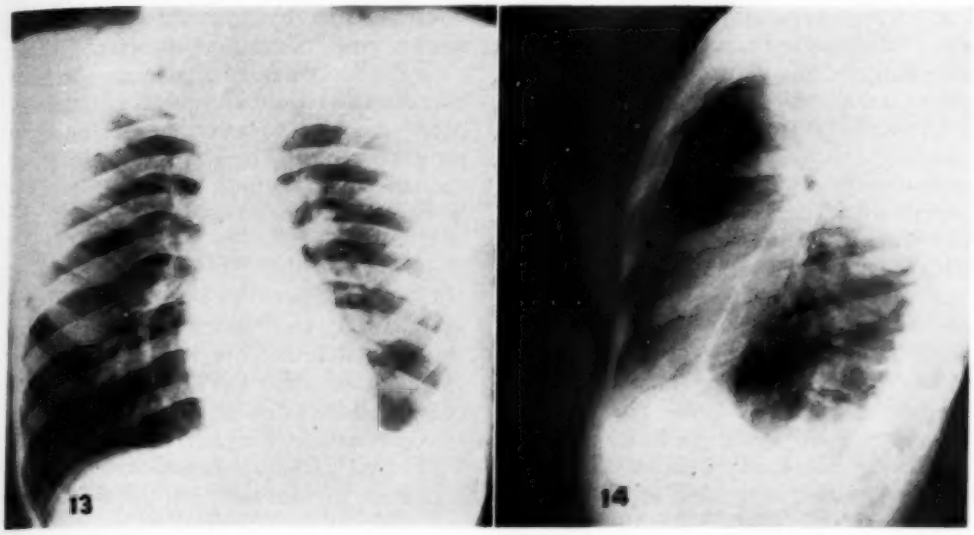
Figs. 9–12. Case II

Fig. 9. Admission film made on Dec. 8, 1949. The infiltration in the left apex, largely hidden by the clavicle and first rib in this view, was of proved tuberculous nature. It will be noted that there is no pleural effusion and the contour of the left border of the heart is normal, with no suggestion of a mediastinal mass.

Fig. 10. Postero-anterior chest film of March 2, 1950. There is a small left pleural effusion and an apparent mediastinal mass projects to the left at the level of the fifth rib anteriorly. Although it cannot be clearly demonstrated in reproductions, this apparent mass could readily be differentiated from the cardiac shadow in the stereoscopic films.

Fig. 11. The mass cannot be identified with certainty in the lateral projection made March 2, 1950, but it is believed to lie far anterior at the level of the fourth interspace.

Fig. 12. Postero-anterior film taken on March 14, 1950. The left pleural effusion has increased slightly in amount and there has been a similar small increase in the size of the mass along the left heart border.



Figs. 13–14. Case II

Fig. 13. Film made April 28, 1950. Although the diaphragm remains adherent laterally, the effusion has cleared and there is no trace of the mass formerly seen just above the left cardiophrenic angle.
Fig. 14. Left lateral chest film of April 28, 1950. The density formerly seen at the level of the fourth intercostal space anteriorly is no longer noted.

suggestive of a mediastinal or paramediastinal mass was found at the time of operation. There were the usual dense adhesions over the site of the disease in the left upper lobe posteriorly. The involved segment was firmly adherent in the gutter and was freed by dissection in the extrapleural plane. The excised specimen showed fibrocaseous tuberculosis with cavitation and tuberculous bronchitis.

The postoperative course was uncomplicated. After a regimen consisting of three months of strict bed rest followed by a three-month period of progressively increasing up time, the patient was discharged from the naval service. Chest films were essentially normal (Fig. 15) and the sputum was consistently negative on culture for *M. tuberculosis*.

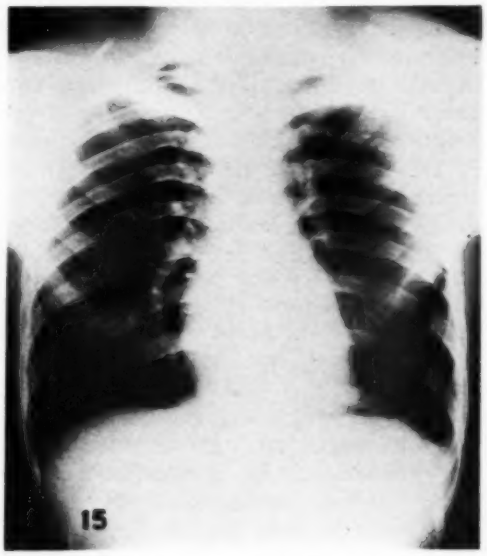


Fig. 15. Case II. Essentially normal film made on discharge from the naval service.

DISCUSSION

It is axiomatic that only by microscopic examination of the excised specimen or a portion thereof can an accurate histologic diagnosis of a mediastinal tumor be made. There are available, however, a number of diagnostic procedures which may yield valuable information in the study of a mediastinal mass. An orderly investigation of these masses, although it will usually fail to establish a definite diagnosis, will commonly point to the proper therapeutic approach, whether it be surgery, irradiation, drug therapy, or a further period of observation.

It seems unnecessary in this brief communication to describe or even enumerate

the various procedures employed in the study of suspected mediastinal tumors. It may fairly be said, however, that the roentgen examination is far more important and informative than any other. Valuable clues as to the probable identity of a mediastinal mass are usually provided by x-ray studies and it is often possible to deduce the probable nature of the lesion on the basis of information obtained from films and fluoroscopy. Those interested in chest medicine and thoracic surgery therefore place great reliance upon the findings revealed by roentgenographic and fluoroscopic examination of the chests of patients who are found to have abnormal masses of increased density apparently situated within the mediastinum. The familiarity of roentgenologists with the usual locations and common characteristics of the various tumors and non-neoplastic masses which may be found within the mediastinum is of the greatest assistance to the clinician in the investigation of lesions in that location. The experienced roentgenologist is also alert to recognize other lesions which may mimic mediastinal masses in their roentgen appearance. The two cases in this paper provide examples of yet another entity which must be considered in the differential diagnosis of apparent tumors of the mediastinum. There is no doubt that in the vast majority of instances patients exhibiting apparent mediastinal masses similar to those shown in the accompanying illustrations, associated with a pleural effusion, will indeed prove to have a mediastinal tumor, frequently of a malignant variety. However, as illustrated by the cases reported herein, the possibility of the mass representing an encapsulated effusion merits some consideration.

SUMMARY

1. Two cases of encapsulated paramediastinal pleural effusion simulating mediastinal tumor are reported. The effusion in one case was on a proved tuberculous basis. The etiology in the other case was not determined.

2. One patient was subsequently subjected to thoracotomy on the side of the previous effusion; no mediastinal mass was present. The former site of the encapsulated effusion was marked only by broad bands of adhesions. The patient who was not explored presented unmistakable roentgen evidence that the apparent tumor consisted merely of an encapsulated effusion.

3. In addition to suggesting another entity which may closely simulate a mediastinal tumor, these two cases again serve to emphasize the extreme importance of reviewing *all* previous chest roentgenograms of patients presenting an abnormal intrathoracic mass.

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SUMARIO

Derrame Pleural Encapsulado Simulando Tumor Mediastínico. Presentación de Dos Casos

Los dos casos descritos son de derrame pleural encapsulado que simulaba tumor del mediastino. En un caso el derrame tenía por base una tuberculosis comprobada. En el otro no se determinó la etiología.

Un enfermo fué objeto después de una toracotomía del lado del derrame anterior. No había tumefacción en el mediastino. El antiguo asiento del derrame encapsulado sólo estaba señalado por anchas franjas de adherencias. El sujeto inexplorado presentaba indudables signos roentgenológicos de que el aparente tumor consistía meramente en un derrame encapsulado.

Además de sugerir la presencia de otra entidad que puede simular muy de cerca tumor mediastínico, esos dos casos sirven de nuevo para recalcar la suma importancia que reviste el repaso de *todas* las previas radiografías torácicas de los enfermos que muestren una masa intratorácica anormal.

Chondrodystrophia Calcificans Congenita

Report of a Case[1]

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THE ROENTGENOLOGIST in the daily practice of his specialty expects to encounter manifestations of disease that are familiar and well known. At times, however, without warning he is confronted by a rare and unusual problem; such an experience can provoke a thrill analogous to that of an explorer discovering new lands or of a student acquiring new and unexpected knowledge. The writer was recently startled in such a manner when he came upon a most bizarre roentgenogram of a newborn infant with extensive congenital anomalies. The exact diagnosis was not immediately apparent and paging through the standard textbooks available yielded a single brief but thorough description, under the designation chondrodystrophia calcificans congenita. This appears in Dr. Bradley Coley's excellent book on Neoplasms of Bone (5).

A review of the world literature was then instituted, revealing a meager total of 22 cases. It is entirely possible, however, that more examples may have been reported under different names, as references were discovered only in the American, British, and German publications, where a considerable confusion in nomenclature already exists. Besides the present name, which was given to the disease by Raap (14) in 1942, it has been called, also, hypoplastic fetal chondrodystrophy, dysplasia epiphysialis punctcularis or punctata, and in one instance was even described under the name of calcinosis universalis.[2]

Chondrodystrophia calcificans congenita belongs to the large and confusing group of bony and cartilaginous embryonic malformations comprising the chondrodystrophies, which has already been subdivided into many ill-defined secondary classifications, frequently merging imperceptibly into one another. It possesses, however, many characteristics not found in any other group, which make it easy to class the condition in its own special niche.

Conradi (6) deserves the honor of being the first to discover and describe the disease, in 1914, and none of the subsequent observers have added materially to his description. In every instance, the disease has been discovered soon after birth, because of obvious deformities, or in the early months or years of life because the general health and growth appeared substandard. The diagnosis is made exclusively by roentgen studies and is based first and foremost upon the discovery of fine stippled, diffuse, dense calcifications in the regions of the epiphyses at any point of the skeleton. Fairbank (8, 9) describes the appearance as "suggestive of that produced by flicking paint from a brush to a clean surface." The shadows are usually discrete and sharp, only a few millimeters in diameter, although there is a somewhat indefinite smudge of semicalcified amorphous material in the background. These calcifications are encountered anywhere in the skeleton where cartilage is normally found. In most of the cases reported, they were present throughout the body, but in a few instances they occurred only in one lower extremity or in the tarsal areas. Most of the patients have died in infancy or early childhood, of varying types of infection, such as pneumonia, tuberculosis, or pyelitis, so that the progress of the cartilaginous disease could not be followed. In the few patients who survived for longer

[1] Accepted for publication in August 1951.

[2] After the present paper was accepted for publication, a report appeared by E. R. Haynes and W. F. Wangner in RADIOLOGY (57: 547, 1951) under the title Chondroangiopathia Calcarea seu Punctata.

periods the calcified material seemed to coalesce and decrease in extent, tending to disappear, according to Raap (14), at the age of three or four.

As stated above, the majority of the patients have shown extensive involvement of the skeleton, with the most frequent and severe calcifications in the tarsal and carpal areas. All bones preformed in cartilage may be and usually are involved, with the calcified material appearing at the ends of the long bones and short tubular bones, in the large flat bones of the pelvis, the chondral ends of the ribs, and the vertebral ossification centers. Furthermore, the calcified stippling has appeared in cartilaginous areas which are never ossified at birth, such as the costal cartilages and the intervertebral disks. In Maitland's (12) first case, as well as in the case to be reported here, the thyroid cartilage showed dense calcified material. At the ends of the long bones especially, the calcifications appear to extend beyond the areas which one would normally expect to be occupied by cartilage, and in some of the few cases seen at autopsy there is a suggestion that the muscular and supporting tissues near the joints are similarly involved. It should be stated, however, that the centers of ossification appear grossly deformed, so that widespread calcifications at the ends of the long bones more probably represent flattened and widened ossification centers.

In addition to the characteristic calcifications, the roentgenograms show unmistakable evidence of chondrodystrophy in the long bones, with shortening and broadening of the shafts and a tendency toward flaring of the metaphyses. There is frequently uneven longitudinal growth of the radius and ulna relative to each other, or of the tibia and fibula, producing lateral or medial deviation of the wrists and feet.

Thus, the three terms used in the name of the disease are well illustrated, namely: *chondrodystrophy* in the shafts of the long bones; *calcifications* throughout the cartilages, and the *congenital* character of the condition.

From a roentgenologic point of view, the chief condition to be considered in the differential diagnosis is epiphyseal stippling in hypothyroid children, but the differentiation should not be difficult, as in hypothyroidism there is no evidence of chondrodystrophy and the cretinoid child examined at a later stage of life shows delayed but well formed epiphyses which are flecked with calcified deposits.

Besides the roentgen changes, there are several other frequently occurring features which help immensely in diagnosing chondrodystrophia calcificans congenita, notably bilateral congenital cataracts and stiffness of the joints.

The eyes were thoroughly examined in 8 of the 22 cases reported and cataracts were found in 6 of these, as well as in the one to be reported here. In the remaining cases, no mention was made as to whether or not there had been an adequate examination of the eyes. This finding is intriguing when one considers that the widespread bony and cartilaginous deformities are of embryonic mesodermal origin, while the eye, including the lens, is an ectodermal structure. According to Hubeny and Delano (11), the condition called lipochondrodystrophy is also associated with corneal opacities.

Stiffness of joints appears to have been mentioned only in passing, in all articles reviewed, but is present in a large number of cases. The main joints, such as the hips, knees, ankles, shoulders, elbows, and wrists, are maintained in semiflexion and show a moderate but definite resistance to extension. This resistance is somewhat reminiscent of the wax-like semirigidity of the joints in Parkinson's disease. It can be explained by Fairbank's report of a case seen at autopsy in which the muscles near the joints were largely replaced by fibrous tissue. Among the cases reported, the presence of stiff joints was recorded in 9 out of 11. The other reports were too sketchy to permit any conclusions.

No other associated features are seen as regularly as the congenital cataracts and the stiff joints. There is no distinct familial tendency, although Raap (14) de-

scribed 4 cases in siblings, 2 of which were in twins. Maitland (12) also discovered the disease in 2 sisters whose father had a congenital absence of several phalanges in the hands and toes. In Tisdall's (17) case, the parents were first cousins. In none of the other patients were there any suggestions of hereditary or familial tendencies in parents or siblings.

Various other abnormalities have been found without any recognizable regularity except possibly for a thin, flabby, scaly skin in 3 cases, as well as in the present patient. There is also a tendency toward a peculiarly formed skull, with such conditions as oxycephaly, bossing of the frontal bones, sinking and flattening of the bridge of the nose being fairly frequently mentioned.

There is no distinct sex preference, as of 17 cases in which the sex was mentioned specifically 8 were in boys and 9 in girls.

As a general rule, the children fare rather poorly and gain weight slowly. Most of the patients have died during the first year of life of some intercurrent infection so that the unavoidable lameness did not become too apparent. Many of the milder cases could not be followed, but Raap showed 2 cases in which the calcifications disappeared during the third year of life.

Reports of histologic studies were found only in articles by Conradi (6), Fairbank (8, 9), Vinke and Duffy (18), and by Coughlin (7). In Fairbank's thorough report, he mentions areas of mucoid degeneration and the formation of cystic spaces in the cartilaginous epiphyses, particularly near the articular surfaces, with occasional invasion of the degenerated areas by blood vessels and a core of fibrous tissue. In the vertebral ossification centers, there was a lack of the usual orientation of cartilage cells and of normal calcification and ossification. The fundamental error appeared to be of the same order as in achondroplasia. Also mentioned are curious circumscribed, polymorphous deposits of chalk in the cartilage, and near these, larger confluent areas of calcification. In other parts, new bone formation was replacing the chalky areas. The zone of ossification between the bone and cartilage at the epiphyseal lines appeared diminished. Conradi's areas of calcification appeared somewhat star-shaped. These authors also found areas of fibrous degeneration in the muscles near the joints. Vinke and Duffy's report closely coincides with these observations, as does the recent article by Coughlin *et al.*

CASE REPORT

Baby girl M. B was born at Holy Cross Hospital (Detroit, Mich.), on May 16, 1951, being delivered from a breech position by Dr. William Coulter. The pregnancy was normal and uneventful. Both parents were in good health. A boy had been born in 1948, and roentgen pelvimetry studies performed just before this first birth showed a normal configuration of the fetal skeleton.

The patient's birth weight was 5 pounds and 4 ounces. Severe abnormalities were noted at once, and Dr. E. O. Jodar, the staff pediatrician, was called in consultation. On physical examination, the baby was seen to be very short, in fact much shorter than expected for a five-pound baby. The head was large in contrast to the length of the child. The skull bones seemed rather firm; the anterior fontanelle was open but smaller than expected. A distinct depression could be felt in the region of the posterior fontanelle and another farther back. The ears were small. The eyes appeared sunken, and the palpebral fissures were definitely narrowed. No discharge from the eyes was seen. The nose and mouth appeared to be normal. The head was held flexed and turned toward the right side. The right arm was shorter than the left and the hand was deviated toward the radial side. The right hand, furthermore, was short and an extra digit was attached to the fifth finger. The left arm seemed short in relation to the remainder of the body. The elbows were held in flexion and showed a moderate degree of resistance to extension. The abdomen seemed to have a very weak wall, so that there was a distinct protrusion in the region of the liver. The spleen could not be palpated. The thorax was short and a distinct depression was noted just below the nipple on each side. The lungs at first seemed to be poorly aerated, but subsequently appeared normal. No abnormal heart sounds were heard. The external genitalia were normal. The lower extremities were short, and the feet were deviated in varus position. A moderate rigidity of the joints of the legs was encountered. The skin was loose and scaly.

Examination of the eyes was performed by Dr. J. C. Gemeroy. Three drops of homatropine, 0.5 per cent, were used to dilate the pupils. The iris was well formed bilaterally. The right lens was fairly clear but showed opacities in the form of spicules in several places along the entire lens. The

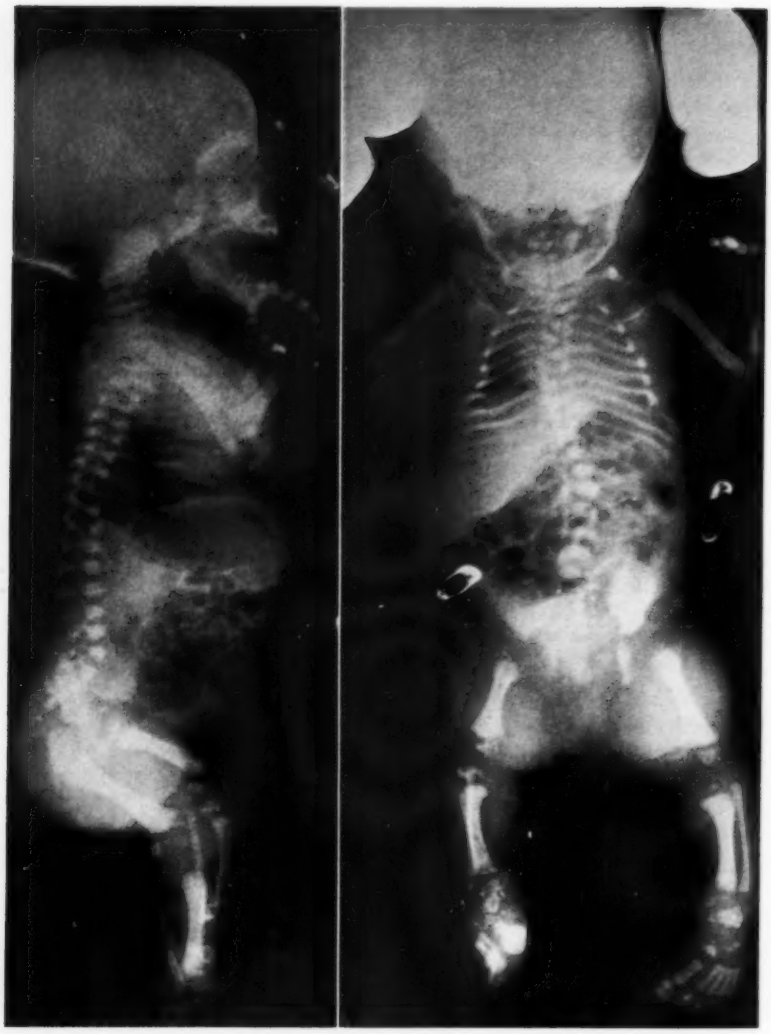

Fig. 1. Chondrodystrophia calcificans congenita. The stippled calcifications throughout the epiphyseal and cartilaginous areas of the body are well shown. Note the calcified thyroid cartilages and the deficient ossification at the base of the occiput. The chondrodystrophic deformities and inequalities in the shafts of the long bones are also very apparent.

center of the lens was sufficiently clear that the fundus could be seen. The optic nerve head was irregular in shape, not distinct, and rather pale. No exudate was seen. The left lens showed definite spicule opacities along the entire lens, involving the fetal nucleus. The adult nucleus was fairly clear as seen through the partially dilated pupil. The optic nerve head was not seen because of the lens opacities. The ocular diagnosis was bilateral congenital cataracts, more advanced on the left, with atrophy and paleness of the left optic nerve head.

Roentgenograms of the entire body of the baby were obtained, revealing small, dense, discrete calcified deposits at either end of all the long bones, with additional extensive depositions in the carpal and tarsal areas, the vertebral ossification centers, the sternum, the cotyloid areas of the pelvis, the chondral ends of the ribs, and even in the thyroid cartilage. These deposits were minute in size, tended to coalesce, and were quite dense.

In addition, the long bones showed manifestations of chondrodystrophy, with short squat diaphyses

and a tendency toward flaring of the metaphyses with an irregular cartilage-shaft junction. The fibulae and the radii were longer than the tibiae and the ulnae. An irregular arrangement of the ossification centers was present in the cervical vertebral area, while the remainder of the spinal column was of relatively normal structure. A rather unusual straightening of the anterior halves of the lower five ribs bilaterally was noted, producing lateral flaring of the lower thorax.

The skull showed a small area of deficient ossification in the occiput above the foramen magnum. The nasal bridge appeared slightly sunken and there was probably some shortening of the base of the skull. The liver shadow appeared rather prominent.

The child was discharged to a crippled children's home in good condition.[3]

SUMMARY

1. A case of chondrodystrophia calcificans congenita is presented, with a review of the literature.

2. The disease occurs in infancy, is very rare, and is diagnosed with certainty only by roentgenographic study.

3. The characteristic roentgen feature is stippling by minute deposits of calcium in the epiphyseal areas of the long bones and in other areas of the body where cartilage is present, as in the tarsal and carpal areas, the ossification centers of the pelvis, sternum, vertebrae, the chondral ends of the ribs, the intervertebral disks, and even the thyroid cartilage. The long bones also show the typical malformations of chondrodystrophy.

4. In a large percentage of cases, there are bilateral congenital cataracts, as well as a peculiar stiffness of the large joints impairing their mobility.

5. There is no definite hereditary familial, or sex predilection.

6. A brief mention of the histologic features is also presented.

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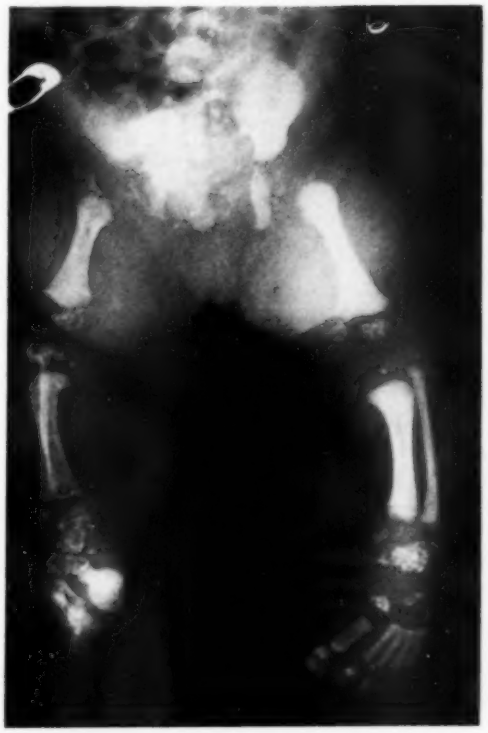

Fig. 2. Showing in more detail the typical calcifications and chondrodystrophic features in the lower extremities.

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SUMARIO

Condrodistrofia Calcificante Congénita. Presentación de un Caso

Esta presentación de un caso de condrodistrofia calcificante congénita va acompañada de un repaso de la literatura. La dolencia ocurre en la infancia, es rarísima y sólo la diagnostica con seguridad el estudio radiográfico. La característica roentgenológica consiste en puntillado debido a diminutos depósitos de calcio en las zonas epifisarias de los huesos largos y en otras zonas del cuerpo donde hay cartílago, como son las tarsianas y carpianas, los centros de osificación de la pelvis, el esternón, las vértebras, los extremos condrales de las costillas, los discos intervertebrales, y hasta el cartílago tiroideo. Los huesos largos muestran además las típicas malformaciones de la condrodistrofia. En un elevado porcentaje de los casos, hay cataratas bilaterales congénitas, así como una rigidez peculiar de las grandes articulaciones. No hay predilección bien definida con respecto a herencia, familia o sexo. También se hace breve mención de las características histológicas.

A Device for Immobilizing Children During Radiographic Examinations[1]

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CHILDREN ARE usually held manually by parents or departmental personnel for roentgenographic studies. There has long been need for a device which would immobilize the child adequately, be safe, simple, and quick to use, permit radiography of various parts of the body in proper positions, and not interfere with the interpretation of the roentgenograms. Such a device would help to insure more adequate radiography of children and would obviate the exposure of personnel frequently entailed. Our experience with the device to be described here, an adaption of a circumcision board, has been surprisingly satisfactory. We have called it a "Brattbored."

The device consists of a series of plywood (3/8 inch, 3-ply) cutouts or "boards," as shown in Figure 1, and a wooden "vise" for holding them. The various "boards" have "head," "arm," "body," and "leg" parts. The "board" with the "arms" beside the "head" is used mainly for erect chest films. It has found use also in fluoroscopy and in pyelography and trunk exposures. The "board" with "arms" out to the side is used mainly for extremity studies in the horizontal position with the child on its back. The space between the "legs" permits the easy introduction of a film for lateral views of the lower extremities. The "board" with "arms" at the sides is used mainly for head and neck studies. The "arm" and "leg" portions are made long enough so that they will fit nearly any child. We found it useful to have infant-sized "boards" two-thirds the size of the "boards" for children. These two sizes have covered our needs. The "boards" are quite radiolucent, but the edges are faintly visualized on the roentgenogram. Knowledge that the "boards" have been used during an examination has prevented misinterpretation of the edge artefact.

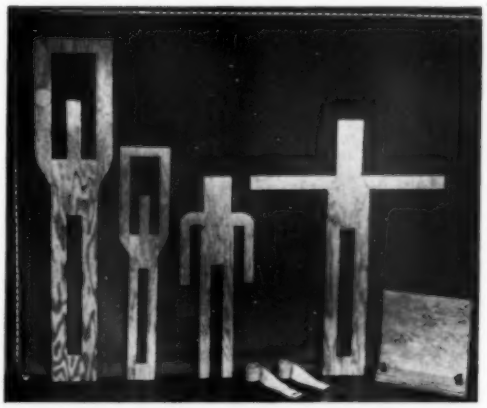

Fig. 1. "Boards" for immobilizing children during radiography and "vise" for holding "boards." The two "boards" on the left are used when the arms are to be bound beside the head. The larger one is for children from a few months to several years of age. The smaller "board" is for infants. The third "board" is used for infants and children when the arms are to be held at the sides. The fourth "board" is for use when the arms are to be held laterally at right angles to the body. In the lower right corner is the "vise" for holding the "boards" vertical to the table top. The jaws are resting horizontally on the table top and the base is vertical. The two elastic bandages are shown between the third and fourth boards. The scales at top and side of the picture are in inches. The vice is 12 inches wide.

The wooden "vise" is used to hold the "board" as shown in Figure 2. The plywood base is 3/4 inch thick, 5 ply, and 12 inches on a side. An upright about 2 inches high, at the end of the base, acts as the fixed jaw of the "vise." Bolts (3/8 inch) with wing nuts hold and fasten the 3/4-inch plywood movable jaw of the "vise." The bolt holes are drilled so that the "board" holding the child can be placed on either side of the "vise." The use of the "vise" permits the "board" to be placed in an erect position on the base,

[1] From the University of California School of Medicine, San Francisco, Calif. Presented as an exhibit at the Thirty-seventh Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1951.

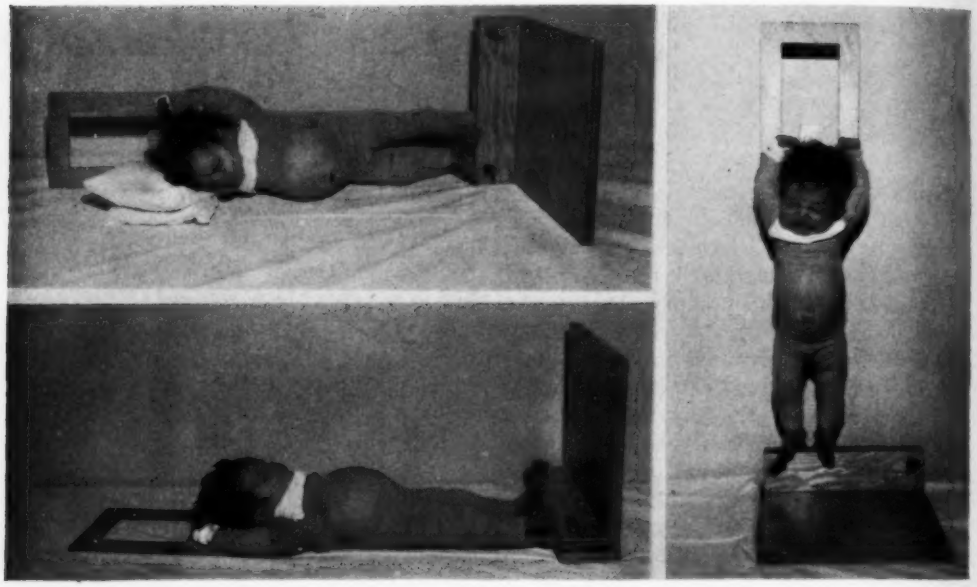

Fig. 2. Method of binding the child to the "board" by means of the elastic bandage and the use of the "vise" to hold the "board" and child in various positions. In the horizontal positions the child is asleep. The child was asleep in the erect position also but was awakened so that he would hold his head up and he is objecting to being awakened. Observe that the "boards" are much longer than the child so that one "board" can be used for children of various sizes. The child in the illustration was bound for an examination of the abdomen. Note, however, that the upper extremities are in proper position for extremity radiography. The space between the lower extremities permits the easy introduction of a film for lateral views of the legs.

where views of the child in an upright position can be taken on films held in a vertical cassette holder. If films are to be taken in the horizontal position, the "board" can be laid on its back. The "vise" can be used to hold the child in the lateral horizontal position as shown in Figure 2. The edge of the "vise" and the edge of the "board" form an L-shaped apparatus, which will hold its position when placed on its side. Both right and left lateral films can be taken with the patient close to the film by proper positioning of the "board" in the "vise."

When one is preparing to immobilize the child, the body of the "board" is placed on a box to lift it away from the table on which one is working. The child's body is placed on the "body" of the "board," so positioned that the upper extremities are in proper relation to the "arms" of the "board." The middle of a 2-inch elastic bandage is then placed across the anterior portion of the pelvis (*not* across the abdomen) and the bandage looped around the pelvis and "board" so that there are two free ends. These free ends are then used to bandage the lower extremities to the "board." It is important that the bandage be smoothly applied. The ends are secured by slipping them under one of the lower turns. Next, the middle of a second 2-inch elastic bandage is placed around the child and "board" and the two free ends are wrapped around the upper extremities.

We have found that it takes about a minute to wrap a child on a "board." This time is well invested. Personnel are not exposed to radiation during the radiography, and the child is well immobilized in good position so that retakes are at a minimum. Many children, if kept warm, seem to be quite comfortable, and more than half of them fall asleep after immobilization.

As mentioned above, it is important that the child be bandaged smoothly. Twists or wrinkles will tend to make the bandage

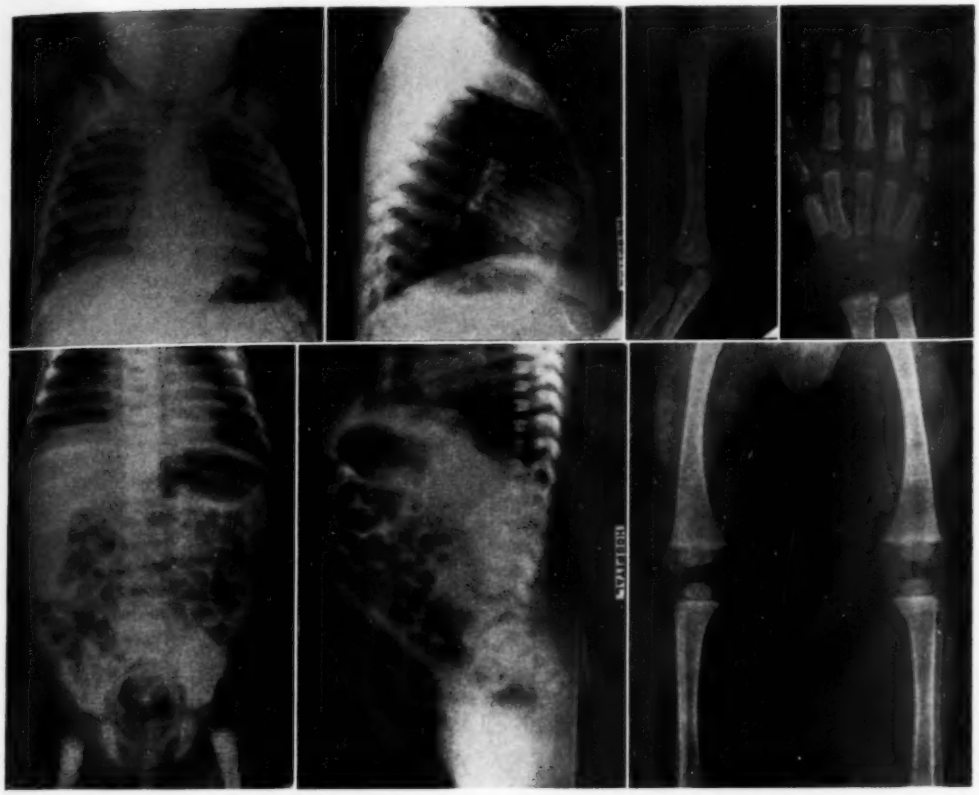

Fig. 3. Radiographs of children bound to the "board" showing the radiolucency of the "board," the edge artefact, and the satisfactory positioning of the patient made possible by the use of the device.

tight locally and thereby interfere with circulation of the extremities. If there is distal cyanosis in one of the extremities, that extremity should be rewrapped properly, and immediately. The bandage should be firmly applied but not tight.

Figure 3 shows some of the radiographs taken with children bound to the "board." Note the edge artefacts which appear as faint straight lines, and the general radiolucency of the boards.

SUMMARY

A simple device, which we have called a "Brattbored," is described for the immobilization of children during radiography. It consists of a series of "boards" made of properly cut pieces of 3/8-inch 3-ply plywood and a wooden "vise." The child is immobilized on the "board" by the application of elastic bandages.

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SUMARIO

Aparato para Inmovilizar a los Niños Durante los Exámenes Radiográficos

El sencillo, pero útil, aparatito descrito es para inmovilizar a los niños durante la radiografía. Consta de una serie de "tablas" preparadas de madera multilaminar de tres dobleces de 9.5 mm. de grueso y de un "tornillo" de madera. El niño quede inmovilizado en la "tabla" mediante la aplicación de vendas elásticas.

EDITORIAL

Irradiation Through Grids

The group of papers on "grid therapy" appearing in this issue of RADIOLOGY provides a good illustration of advances in radiotherapy brought about by taking advantage of biological phenomena. They present the opportunity to emphasize the importance of distinguishing clearly between advantages brought about by changes in physical factors and those resulting from modifications of biological phenomena.

The successful treatment of a deep-seated tumor by x-rays depends on numerous physical and biological factors. In the past much attention has been paid to the manipulation of the physical factors to bring about a favorable distribution of the radiation both in the tumor and the surrounding normal structures. High-voltage x-rays, cross-fire irradiation, and rotation therapy, for example, have been developed with this end in view. It is obviously desirable to take advantage of all "tricks of the trade" to bring about the most advantageous distribution of radiation in the patient's body—and there is still room for improvement in this respect. There is, however, an inherent difficulty that no juggling of physical factors can overcome, and that is the relative radiosensitivity of the tumor with respect to the surrounding tissues.

In most cases there is no sharp line of demarcation between the tumor and the normal tissues around it. Therefore, in order to destroy the infiltrating cancer, it is necessary in general to irradiate heavily a large volume of normal tissue. Severe permanent damage to such tissues, or to the patient as a whole, is therefore the ultimate limiting factor in radiotherapy. Hence, after all possible efforts have been made to bring about the most favorable distribution of radiation within the patient's body, further progress can be made only by modifying favorably the relative radiosensitivity of the tumor with respect to the normal tissues.

This is purely a biological problem, but favorable modifications of biological responses may be brought about by modifications of some physical factors. Thus, the use of supervoltage x-rays in the treatment of deep-seated tumors is indicated because of (1) better distribution of radiation within the body, and (2) relatively greater skin tolerance. The former is purely a physical phenomenon, whereas the latter is a biological phenomenon brought into action by a change in a physical characteristic of the radiation, namely, the wave length. A better example is the improvement in clinical results obtained with the fractionated dose method of treatment as contrasted with the single (massive) dose method. Obviously, in this case, the relative spatial distribution of dose within the patient's body is exactly the same in the two cases. However, prolongation of the period during which the radiation is administered increases the dose required to destroy the tumor, but at the same time it increases even more the dose that the normal tissues and the body as a whole can tolerate. The result is a net gain in differential effect. This again is a biological phenomenon elicited by a change in one physical factor—the time of administration of the radiation.

The clinical results obtained by irradiation through the grid must be interpreted in a similar manner. Any improvement must be attributed to the interplay of biological phenomena brought into action by the peculiar spatial distribution of the radiation, especially since the spatial distribution is worse with the grid than with

the open port. The advantage comes from the fact that recovery of markedly over-irradiated small volumes of tissue can take place when each of these volumes is surrounded by tissues that have not been damaged too severely. Therefore, the total dose delivered to the tumor can be larger than with the open port, in spite of the fact that the relative depth dose is lower. On purely physical grounds one would not expect better clinical results with the grid technic.

The writer is of the opinion that the grid technic is of definite value and should be used more extensively. A word of caution is in order, however. The statement that the skin can tolerate 3,300 r in air through an open port and 24,000 r in air through the grid (all other conditions being the same) would imply that the final damage is the same in both cases. This, however, cannot be so, since the minimum skin dose—in the areas protected by the lead rubber—is the same in both cases and the skin dose in the exposed areas is about six times greater. For the skin effect over the entire area to be the same, it would be necessary to assume that the *additional* 500 per cent increase in skin dose (total 600 per cent) in the exposed areas is entirely without effect. The only possible way out of this dilemma is to assume that 3,300 r in air through an open port does not really represent the tolerance limit of the skin and that 24,000 r in air through the grid must produce more severe skin damage. The same reasoning applies with more force to the underlying tissues because of the greater overlapping of the beams through scattering. Therefore, 24,000 r through the grid must be a more severe treatment to the patient than 3,300 r with an open port, all other conditions being the same. This would indicate that the clinicians have been more daring with the grid technic than they were with the open port method.

Substantiation of this conclusion is furnished by Dr. Harris' statement that the constitutional reactions from the grid treatment with fields up to 20 × 20 cm. at the rate of 1,200 r in air per day are no worse than those encountered when 250 r in air is given to an open portal of a similar size with 200 kv. Here the ratio of the air doses is 1,200/250 = 5 instead of 24,000/3,300 = 7, so that for a total air dose of 24,000 r through the grid the corresponding open port dose would be 4,800 r. Accordingly, those who believe that 3,300 r in air represents the practical limit of tolerance with an open port should not attempt to give much more than 5 × 3,300 r = 16,500 r through the 40 per cent grid. With this ratio of air doses (5 to 1) there is still a considerable advantage in depth dose, especially if precautions are taken to insure a better overlap of the beams in the tumor.

The last figure in Dr. Loevinger's paper shows a marked difference between the grid maximum and grid minimum depth doses, even at 10 cm. depth. This is a serious drawback, for, if we assume that normal tissues can recover more readily when alternate small volumes are irradiated heavily and lightly, we must expect the same thing to take place in the tumor. Actually in practice there must be considerable overlapping at this depth when several separate treatments are given through the same skin area and the difference between maximum and minimum tumor dose must be considerably less than the theoretical value. The important point is, however, that a deliberate effort should be made to bring about a more uniform distribution of radiation in the region of the tumor. It can be done by changing slightly the *angulation* of the beam at each treatment while maintaining accurate registry of the grid pattern on the skin. Overlapping is also facilitated by using the grid in conjunction with the cross-fire technic. In fact, advantage should be taken of all pertinent technical devices available to the radiologist. However, one should proceed cautiously, since the factors involved are largely biological and are not so well known or controllable as the physical factors.

Extension of the technic to x-rays of higher voltage should be interesting. Physical measurements in conjunction with

present clinical experience can serve as a very useful guide in this case. Extension to rotation therapy should also be undertaken, although the practical difficulties are considerable. It could be carried out, at least in some cases, by making an exact plastic mold of the body region to be irradiated and attaching the grid permanently to the mold.

It may be pointed out now that the inherent limitation of external radiation therapy arising from the infiltration of normal tissues around the tumor, and the lack of high differential radiosensitivity of most tumors, applies also to the grid technic. The favorable modification of biological factors which it brings about is limited to tissues well outside of the volume in which tumor involvement must be assumed to exist. Therefore, one should not expect a very marked improvement in clinical results—though even a small improvement is worth while. In fairness, it should be pointed out that the same general limitation applies to all possible procedures that do not influence appreciably the *relative* radiosensitivity of the tumor and the tissues immediately adjacent to it. For the same reason *marked* improvements in clinical results cannot be expected from the use of multi-million volt x-rays. Nevertheless, pessimism as to the future of radiation therapy is not justified.

In the first place, several small improvements acting together become of substantial practical importance, as proved by the progress that has been made in the last twenty-five years. Then there are at least two possibilities for really great improvement. One is the development of radioactive chemical compounds capable of localizing in cancer tissue with a very high degree of selectivity with respect to normal tissues. In this case the destructive action of the radiation could be confined essentially within tumor tissue. Another possibility is the development of means (physical, chemical, or biological) capable of substantially increasing the *relative* radiosensitivity of a tumor with respect to the surrounding normal tissues and the body as a whole. In this case it is immaterial whether the favorable differential effect is brought about by an increase of the radiosensitivity of the tumor or a decrease in the response of the normal tissues, or indeed by an increase in the recuperative power of normal tissues. There are indications at present that progress along all these lines is not too far away.

In the meantime, any improvement is worth while, and the authors of the three papers deserve credit for demonstrating the practicability of the grid technic by careful experimental and clinical observations.

G. FAILLA, Sc.D.

The Ever-Widening Scope of Radiology

When the Radiological Society of North America in 1923 chose the name RADIOLOGY for its new official journal, it assumed the responsibility of including within its scope the field of radium therapy as well as roentgen diagnosis and therapy. With the development of nuclear physics and its application to the medical sciences, the wisdom of this choice became even more apparent. Implicit in the title was the inclusion of radiation from nuclear sources, and, indeed, of all types of radiation now in use or to be developed in the future.

As early as 1942 one complete issue of RADIOLOGY was devoted to a symposium covering the cyclotron, certain of the radioactive elements, and neutron radiation, and the applications of these newer agents in research and medicine. Other outstanding symposia, which have appeared during the intervening years, have been those on the plutonium project and on radiological defense with special reference to the atomic bomb. Throughout this period, also, numerous individual papers concerned with nuclear physics have been published and the scattered literature in this field has been brought together in the abstract section.

With continued research, modifying our scientific conceptions and adding to our knowledge, RADIOLOGY will pursue its established policy of covering the broad field implied by its name, seeking always to maintain a proper balance between the clinical and research aspects of radiation.

ANNOUNCEMENTS AND BOOK REVIEWS

FOURTH INTER-AMERICAN CONGRESS OF RADIOLOGY

The Fourth Inter-American Congress of Radiology will be held in Mexico City, Nov. 2–8, 1952, under the direction of the Sociedad Mexicana de Radiologia. Dr. Manuel F. Madrazo, F.A.C.R., is the President of the Congress; Dr. Guido Torres Martinez, Secretary-General; Dr. Narno Dorbecker C., Secretary for Latin America; Dr. Guillermo Santin, Secretary for the English Speaking Countries; Dr. Baudelio Villanueva, Treasurer.

The official themes for the Congress are: (A) The Radiological Diagnosis of Intra-Abdominal Tumors, Other than Gastro-Intestinal; (B) Radiotherapy of Lymphosarcoma Hodgkin's Disease, and the Leukemias. However, the program will not be limited to these two subjects. The Committee extends an invitation to the radiologists of the United States to offer papers on any topic. Twenty minutes will be allowed for each presentation. The titles and an abstract of the material to be presented should be sent to Dr. James T. Case, Chairman of the American Delegation to the Fourth Inter-American Congress of Radiology, 2315 Bath St., Santa Barbara, Calif. The complete text of the paper must be in Dr. Cases's hands not later than June 30, 1952.

The registration fee for Regular Members (professors of radiology, heads of departments of radiology, and other radiologists recommended by radiological societies) will be $200.00 pesos (mex./Cy.) or its equivalent in American dollars ($24.00). For Associates (relatives of Regular Members, technicians, manufacturers' representatives), the fee is half this amount. These fees are payable before Aug. 31. After that date they will be increased to $30.00 and $15.00, respectively. Checks and money orders should be made payable to Dr. Baudelio Villanueva.

Information regarding scientific exhibits may be obtained from Dr. Luis Vargas y Vargas. Applications for such exhibits must be received by July 31. Arrangements for commercial exhibits should be made through Dr. Jorge Deschamps L.

Members of the Congress may make their travel arrangements through any agent of Thomas Cook & Sons, which has been selected as the official agency by the Congress, or any travel agency of their choice.

All communications, except as otherwise noted, should be addressed to the appropriate officer or committee at Londres 13, Mexico 6, D. F.

NOTICE TO ALL DIPLOMATES OF THE AMERICAN BOARD OF RADIOLOGY

There have been many changes of address among the diplomates of the American Board of Radiology in recent years and we find that frequently we have not been notified of them. If any diplomate has changed address since certification and has not advised us, we would appreciate it if he would notify us of his present address. This will enhance our records and simplify the preparation of the next edition of the *Directory of Medical Specialists*, Notices should be sent to the undersigned.

B. R. KIRKLIN, M.D.
Mayo Clinic
Rochester, Minn.

KENTUCKY RADIOLOGICAL SOCIETY

The newly elected officers of the Kentucky Radiological Society are Dr. E. Lee Shiflett, of Louisville, President; Dr. James S. Rich, of Lexington, Vice-President; Dr. Everett L. Pirkey, 323 East Chestnut St., Louisville 2, Secretary-Treasurer. Dr. Sydney E. Johnson, of Louisville, was named Counsellor of the American College of Radiology.

OHIO STATE RADIOLOGICAL SOCIETY

The Annual Meeting of the Ohio State Radiological Society will be held May 24 and 25, in Mansfield, Ohio, at the Mansfield-Leland Hotel. This meeting is not being held in conjunction with the State Medical Association meeting.

PENNSYLVANIA RADIOLOGICAL SOCIETY

The Pennsylvania Radiological Society will hold its Annual Meeting at Bedford Springs Hotel, Bedford, Penna., May 16 and 17.

ST. LOUIS SOCIETY OF RADIOLOGISTS

At a recent meeting of the St. Louis Society of Radiologists, the following officers were elected for the year 1952: Dr. Hyman R. Senturia, President; Dr. Donald S. Bottom, Vice-President; Dr. Francis O. Trotter, Jr., 634 North Grand Boulevard, St. Louis 3, Secretary-Treasurer.

ARGENTINE CONGRESS OF RADIOLOGY

The Fourth Argentine Congress of Radiology will be held in Santa Fe, Argentina, July 23–26, 1952, under the auspices of the Asociación Argentina de Radiología. The central themes of the Congress are Cancer of the Breast, Malignant Tumors of the Bones, and Radiologic Diagnosis of Abdomino-Pelvic Tumors. North American radiologists will be made most welcome. For further details, application should be made to Dr. Raul Mayer, Chairman of the Congress, San Jerónimo 3472, Santa Fe, Argentina.

INDIAN RADIOLOGICAL ASSOCIATION

An announcement has been received of the Annual Indian Radiological Congress held in Bombay, Feb. 8–11, 1952. Dr. S. N. Deboo, M.B.B.S., M.R.C.S., L.C.P.S., of Bombay, has been elected President of the Indian Radiological Association for 1952.

JOSEPH FREEDMAN LECTURES UNIVERSITY OF CINCINNATI

On Saturday and Sunday, April 26 and 27, 1952, Dr. David G. Pugh, Associate, Section of Roentgenology of the Mayo Clinic, and Assistant Professor of Roentgenology, University of Minnesota, will deliver the fourth annual Joseph Freedman Lectures in Diagnostic Roentgenology at the University of Cincinnati College of Medicine. Roentgenologists desiring to attend should write Dr. Benjamin Felson, X-Ray Department, Cincinnati General Hospital, for further details.

CANCER SYMPOSIUM UNIVERSITY OF TEXAS

The Sixth Annual Symposium on Fundamental Cancer Research of the University of Texas M. D. Anderson Hospital for Cancer Research will be held April 25 and 26, at the Shamrock Hotel, Houston. At the same time there will be held a Cancer Pathology and Radiology Conference on Tumors and Other Diseases of Bone under the joint direction of Dr. Granville Bennett, Professor of Pathology, University of Illinois, and Dr. L. Henry Garland, Professor of Radiology, Stanford University Medical School. Further information may be obtained from William O. Russell, M.D., 2310 Baldwin St., Houston 6, Texas.

ISOTOPE COURSES, OAK RIDGE

Three additional courses in the technics of using radioisotopes in research will be offered by the Special Training Division of the Oak Ridge Institute of Nuclear Studies in the summer of 1952. Dates for the courses are: June 9 to July 4; July 7 to Aug. 1; Aug. 11 to Sept. 5.

The courses are designed to acquaint mature research workers with the safe and efficient use of radioisotopes in research. Each course is open to 32 participants.

Application blanks and additional information may be obtained from Ralph T. Overman, Chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn.

AMERICAN CONGRESS OF PHYSICAL MEDICINE

The thirtieth annual scientific and clinical session of the American Congress of Physical Medicine will be held Aug. 25–29, at The Roosevelt Hotel, New York, N. Y. In addition to the scientific sessions, annual instruction seminars will be conducted. Full information may be obtained by writing to the American Congress of Physical Medicine, 30 North Michigan Ave., Chicago 2, Ill.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest to our readers and as space permits.

X-RAY INTERPRETATION. By H. CECIL H. BULL, M.A., M.B., M.R.C.P., Honorary Consulting Radiologist to the Royal Waterloo Hospital, London, and the General Hospital, Southend-on-Sea, with a chapter on "Radiography of the Head," by JAMES W. D. BULL, M.A., M.B., M.R.C.P., D.M.R., Assistant Radiologist, St. George's Hospital; Radiologist, Maida Vale Hospital for Nervous Diseases; Assistant Radiologist, National Hospital. A volume of 406 pages, with 287 illustrations. Published by Oxford University Press, New York, 2d ed., 1951. Price $5.50.

THE PHOTOGRAPHY OF PATIENTS, INCLUDING DISCUSSIONS OF BASIC PHOTOGRAPHIC AND OPTICAL PRINCIPLES. By H. LOU GIBSON, F.B.P.A., A.P.S.A., Medical Division, Eastman Kodak Company, Rochester, New York. Publication No. 95, American Lecture Series. A monograph of 118 pages, with 93 illustrations, 4 in color. Published by Charles C Thomas, Springfield, Ill. Price $5.50.

PHYSICIANS FEDERAL INCOME TAX GUIDE, 1952 Edition, for the Preparation of 1951 returns and 1952 estimates. By HUGH J. CAMPBELL and JAMES B. LIBERMAN. A volume of 112 pages. Published by Doniger & Raughley, Great Neck, N. Y. Price $2.50.

ELEVENTH SEMIANNUAL REPORT OF THE ATOMIC ENERGY COMMISSION, January 1952. 212 pages, Published by the United States Government Printing Office, Washington, D. C.

THORACIC AORTOGRAPHY, WITH SPECIAL REFERENCE TO ITS VALUE IN PATENT DUCTUS ARTERIOSUS AND COARCTATION OF THE AORTA. Acta Radiologica Supplement 89. By GUNNAR JÖNSSON, BROR BRODÉN, and JOHAN KARNELL. From the 1st Department of Diagnostic Radiology of Södersjukhuset, Stockholm, Sweden (Head: Docent G. Jönsson). In co-operation with the 2nd Medical Clinic of Södersjukhuset, Stockholm (Head: Prof. G. Nylin). Stockholm, 1951. Price Swed. Cr. 30.

LEHRBUCH DER RÖNTGENDIAGNOSTIK. By H. R. SCHINZ, W. E. BAENSCH, E. FRIEDL, E. UEHLINGER, with contributions by E. BRANDENBERGER, A. BRUNNER, U. COCCHI, N. P. G. EDLING, J. EGGERT, F. K. FISCHER, M. HOLZMANN, H. KRAYENBÜHL, Å. LINDBOM, E. LINDGREN, G. A. PREISS, S. WELIN, and A. ZUPPINGER. 5. Lieferung. Innere Organe. A volume of 436 pages, with 522 illustrations. Published by Georg Thieme, Stuttgart, 5th completely revised edition, 1951. Distributors for U. S. A. and Canada: Grune & Stratton, Inc., New York.

ATELEKTASEN DER LUNGE. DIE VERSCHIEDENEN FORMEN, IHRE ENTSTEHUNG UND BEDEUTUNG. By PROF. DR. MED. HANNS ALEXANDER, Landes-Schirmbildstelle Hannover. Monographien zur Monatsschrift "Der Tuberkulosearzt," herausgeben von DR. ROLF GRIESBACH und PROF. DR. OTTO WIESE. A monograph of 58 pages, with 4 drawings and 53 roentgenograms. Published by Georg Thieme, Stuttgart, 1951. Distributor for U. S. A. and Canada: Grune & Stratton, Inc., New York.

KLINISCHE ELEKTROKARDIOGRAPHIE. LEHRBUCH FÜR STUDIERENDE UND ÄRZTE. By DR. MAX HOLZMANN, Zürich. A volume of 652 pages, with 302 illustrations. Published by Georg Thieme, Stuttgart, 2d ed., 1952. Distributor for U. S. A. and Canada: Grune & Stratton, Inc., New York.

ACTAS DEL TERCER CONGRESO INTERAMERICANO DE RADIOLOGÍA, Chile, 1949. A volume of 746 pages, with numerous illustrations and tables.

LES SYNDROMES DOULOUREUX DE LA RÉGION ÉPIGASTRIQUE. Vol. II. By RENÉ-A. GUTMANN, Médecin des Hôpitaux de Paris. A volume of 860 pages, with 1,271 roentgenograms and 411 drawings. Published by G. Doin & Cie, Paris, 5th ed., 1951.

Book Reviews

ROENTGEN-DIAGNOSTICS. By H. R. SCHINZ, W. E. BAENSCH, E. FRIEDL, E. UEHLINGER. First American Edition (Based on the Fifth German Edition). English translation arranged and edited by JAMES T. CASE, M.D., D.M.R.E. Volume I, Skeleton (Part I), 868 pages, with 1,183 illustrations. Published by Grune & Stratton, New York, 1951. Price $36.00.

The long-anticipated American edition of the authoritative work on diagnostic roentgenology by Schinz and his collaborators has become a reality. Volume I of a projected set of five volumes is now available. The American edition, based on the fifth German edition, now in course of publication, has been arranged by Dr. James T. Case, whose linguistic attainments and long experience in radiology insure an idiomatic translation with due regard for American standards and terminology.

This first volume is one of two to be devoted to the skeleton. It opens, however, with a consideration of the basic principles of roentgenography, filling some 100 pages and covering the theory of the roentgen image, protective measures, fine-structure analysis, and general considerations of technic and interpretation. Much of the material in this section is basic to an adequate understanding of roentgenology and will prove invaluable to the student.

The following chapters take up in succession the roentgen study of normal and pathologic skeletal structures, with special reference to bone growth, maturation, and variations produced by modifying influences. A large section, by G. A. Preiss, is given over to fractures, much space being devoted to the fundamental mechanisms involved, as well as the types of fractures, their healing, treatment, and complications. Basic factors are again stressed in the chapter on aseptic necrosis, which discusses in turn spontaneous, occupational, and traumatic osteonecroses.

Inflammatory diseases of the bone are considered at length, with a thorough discussion of their fundamental anatomic and pathologic features. The concluding chapter, by U. Cocchi, is devoted to hereditary disease with bone changes. In some 200 pages there are included descriptions of practically all types of congenital abnormalities of the skeletal system.

The book is attractively bound and well printed, with a wealth of illustrations, including numerous charts, many of them in two colors. It is regrettable, however, that the roentgenograms are reproduced in the positive instead of the more familiar negative form. An excellent bibliography follows each chapter. An index would have been a useful addition, but it is assumed that this will appear either in the second volume on the bones or in the concluding volume of the series.

This initial volume may be regarded as a promise to bring us in English the finest treatise on roentgen diagnosis that has yet appeared. Its treatment of the subject is basic and comprehensive. It is replete with information which will be of interest to the clinician as well as the radiologist. A work so fundamental in its concept will be in demand in hospital and medical school libraries and will find a place of pre-eminence in the collections of individual radiologists.

CHILDREN'S RADIOGRAPHIC TECHNIC. By FORREST E. SHURTLEFF, R. T., The Children's Medical Center, Boston, Mass. A volume of 80 pages, with 32 illustrations and 41 tables. Published by Lea & Febiger, Philadelphia, 1951. Price $3.75.

This book of 80 pages contains brief descriptions of the many types of radiographic examination per-

formed on children. The technics described are those practised in any carefully conducted radiologic department. Forty-one tables of technic are included, designed to be used in examination of various parts of the body. The novel approach here lies in relating the technical factors to the age group of the child rather than the thickness of the part in centimeters. A check of these technics indicates that they are quite satisfactory and usable. The book will undoubtedly be found of value in the newly organized x-ray department where good pediatric technics must be established.

RENAL PELVIS AND URETER. By PETER A. NARATH, M.D., F.I.C.S., Adjunct Professor of Urology, New York Polyclinic Medical School and Hospital. A volume of 420 pages, with 264 figures. Published by Grune & Stratton, New York 16, N. Y., 1951. Price $12.50.

Motivated by the lag in knowledge of basic sciences pertaining to a specialty as compared to the tremendous progress in the specialty, the author has compiled a comprehensive and detailed volume on the basic anatomical and physiological concepts regarding the renal pelvis and ureter. The book is written in lucid form, but requires more than casual study if full benefit is to be derived from it.

Much of the work is original with the author. He deals at length with the embryology, anatomy, histology, physiology, and motor dynamics of the calyces, pelvis, and ureter, and includes quite a complete treatise on the arterial, venous, lymphatic, and nervous supply, with illustrations and description of aortography for visualization of the renal vessels. The book is completed with accounts of retrograde and intravenous pyelography, stressing many of the salient features conducive to illuminating studies. The illustrations and reproductions are of good quality and many are further elaborated on by diagrams and sketches. An extensive bibliography, dating as far back as 1677, is appended.

This work should serve as a useful reference in the library of anyone especially interested in the urinary tract, particularly the urologist and radiologist.

TUMORS OF THE EYE. By ALGERNON B. REESE, M.D., D.Sc. (Hon.), F.A.C.S., Attending Ophthalmologist and Pathologist, Institute of Ophthalmology, Presbyterian Hospital, New York; Ophthalmologist to Memorial Center for Cancer and Allied Diseases, New York; Clinical Professor of Ophthalmology, College of Physicians and Surgeons, Columbia University. A volume of 574 pages, with 511 illustrations, 122 in full color. Published by Paul B. Hoeber, Inc., New York, 1951. Price $20.00.

This volume is a comprehensive treatise on tumors of the eye, together with their relation to local and generalized disease processes. It would appear to be the first such publication since that of LaGrange in 1901. The author's long association with the Memorial Center for Cancer and Allied Diseases (New York) has given him a unique opportunity of studying ocular tumors in their relation to tumors elsewhere in the body, and it is upon his own experience and personal convictions that the book is based, though frequent reference is made to the observations of others.

Individual chapters are devoted to the various tumor types, covering the symptomatology, clinical findings, pathology, prognosis, and treatment. The terminology is simple and follows closely common usage. The clinical descriptions are excellent. The sections on treatment are largely devoted to surgical procedures. The author gives the impression of a lack of confidence in, or of unfamiliarity with, the technic and results of modern radiotherapy.

The book is beautifully printed and well illustrated. More than one hundred photographs in color constitute a notable feature. A bibliography is appended to each chapter.

This very complete work is a must for opthalmologists. It will be valuable also to those who are interested in tumor pathology, and radiologists called upon for radiotherapy of ocular neoplasms will find it a helpful source of information.

KYMOGRAPHISCHE RÖNTGENDIAGNOSTIK. ZUR BEURTEILUNG DES HERZENS IN BEISPIELEN. By PROFESSOR DR. PLEIKART STUMPF, München. A monograph of 120 pages, with 164 figures. Published by Georg Thieme, Stuttgart, 1951. Distributors for U. S. A. and Canada: Grune & Stratton, Inc., New York 16, N. Y.

Technically simple, inexpensive, immensely useful, the kymogram has met with neglect out of all proportion to its true worth. The difficulties of interpretation, which have occasioned this neglect, have been overcome by few workers. One of these, Dr. Pl. Stumpf, offers another monograph on diagnostic roentgenkymography as applied to the heart. There is merited hope for its acceptance.

Less than six introductory pages outline the basic principles of moving grid kymography. The author assumes that the reader is already acquainted with them. The remainder of the text consists of forty examples selected from his patient referrals. Each example follows a specific format which gives the whole work a distinctive didacticism:

(*a*) Patient data, such as age, sex, weight, brief history, and summary of clinical findings
(*b*) Electrocardiogram
(*c*) Fluoroscopic and kymographic findings
(*d*) Roentgenkymographic opinion
(*e*) Explanation

The wide variety of examples include the normal heart, valvular heart disease, myocardial infarction,

myocardial weakness, arrhythmia, aortic sclerosis, pericardial disease, aneurysm, mediastinal tumor, and foreign body. The explanation or enlightenment is the true body of the monograph. On the principle that "the form of the kymograph curve is no accidental product, but directly depends upon functional events," the wave variations as induced by disease are analyzed, interpreted, and discussed. Where possible, diagnostic criteria are summarized, as for Example 25: "A contractile dysfunction is to be assumed if, after exercise, the cardiac shadow enlarges, the amplitude of the left ventricular waves diminishes, the auricular movements on the right increase, the right heart border bulges outward, back pressure waves become larger or appear for the first time."

The drawback to a wide circulation of this book will be its limited audience. It calls for a German-reading physician interested in kymography. There may be an additional preferential criticism in that, while Stumpf favors the moving grid kymogram, in this country the moving film variety is more popular.

ROENTGEN ANATOMY (ROENTGEN ANATOMÍA). By DAVID STEEL, M.D., St. John's Hospital and Evangelical Deaconess Hospital, Cleveland, Ohio. A volume of 108 full-page plates. Published by Charles C Thomas, Springfield, Ill., 1951. Price $8.00.

This is a rather limited atlas of roentgen anatomy as demonstrated in standard positions, without the aid of contrast media. It is made up of 54 plates and corresponding drawings with legends in Spanish and English. On each right-hand page is a roentgenogram as it would appear in routine practice, while on the facing page is a diagram on which the anatomical landmarks are indicated by numerals, explained in the accompanying legends.

In a number of the radiographs some detail has been lost in reproduction, but in general the anatomic features are fairly well depicted. With the exception of four views of the heart, all demonstrate bony landmarks. It is to be regretted that the subject of roentgen anatomy has not been more completely covered, with views of the soft tissues, lung lobes and segments, vascular system, brain and spinal cord, and other structures which are under daily study.

So far as it goes, however, the book is well done and will be a welcome addition to the library of the practising radiologist and the student of radiology.

In Memoriam

XIMIE RICHARD HYDE, M.D.
1892–1951

Ximie Richard Hyde died at his home in Fort Worth, Texas, July 21, 1951, at the age of fifty-nine, after an extended illness.

Ximie Richard Hyde, M.D.

Doctor Hyde was born on Nov. 27, 1892, at Sulphur Springs, Texas, the son of John T. and Georgia Hyde. He attended public schools in Sulphur Springs and received his pre-medical training at Burleson College in Greenville. In 1915 he was graduated from the Medical Department of Texas Christian University.

Called into active service in the National Guard during his senior year, Dr. Hyde served on the Texas-Mexico border against Pancho Villa. He began his medical practice in Dodson, Collingsworth County, Texas, where he engaged in general practice for five years. He then took graduate training in radiology at Loyola University, Chicago, and became affiliated with the radiology department of St. Bernard's Hospital in that city. Later he served at Loyola as an instructor. Dr. Hyde returned to Fort Worth in 1925, to specialize in radiology and served as chief of the department of radiology at the City-County Hospital for more than twenty years. He was a diplomate of the American Board of Radiology, a fellow of the American College of Radiology, and a member of the Radiological Society of North America, the Rocky Mountain Radiological Society, the Texas Radiological Society, of which he had been secretary and president, and the Dallas-Fort Worth Inter-City Radiological Society, which he helped to organize. He also served as secretary of the National Physicians Committee in Texas.

A member of the American Medical Association and of the Texas Medical Association through Tarrant County Medical Society, Dr. Hyde served the state organization as chairman of the Section on Radiology in 1934, vice-president in 1947, and chairman of the Committee on Scientific Exhibits since 1940. He had held office in the Tarrant

County Medical Society and was also a member of the Thirteenth District Medical Society. He was a Rotarian, a Mason, and a Baptist, and a member of the Phi Chi medical fraternity.

On July 2, 1919, in Wellington, Texas, Dr. Hyde married Miss Kate Marie Dodson, who survives. He is survived also by his two daughters, Mrs. Kelly Shryoc and Mrs. William Dwight Dobson, Jr., of Fort Worth, and his mother, Mrs. J. T. Hyde, of Dallas. Dr. Hyde will be missed by his many friends in Texas, and particularly by his fellow radiologists in the Fort Worth-Dallas area.

GLENN D. CARLSON, M.D.

B. SWAYNE PUTTS, M.D.

1882–1952

Dr. B. Swayne Putts, of Erie, Penna., died at Fort Lauderdale, Fla., Jan. 31, 1952, of arteriosclerotic cardiovascular disease, which had forced his retirement from active practice in 1947.

Born in Baltimore, Md., Dr. Putts was graduated from Johns Hopkins University in 1902 and received his medical degree from that university in 1906. Having served his internship at the Allegheny General Hospital, Pittsburgh, he spent several years working in tuberculosis hospitals. In 1916 he returned to Johns Hopkins Hospital for graduate training in roentgenology under Doctor Baetjer. He became roentgenologist to Hamot and St. Vincent's Hospitals in Erie and continued in this capacity throughout his lifetime. He was a diplomate of the American Board of Radiology, a fellow of the American College of Radiology, and a member of the Radiological Society of North America and the American Roentgen Ray Society. He was a past-president of the Pennsylvania Radiological Society and the Erie County Medical Society.

In his younger days Dr. Putts had enjoyed lacrosse, tennis, and golf. More recently he had become known locally as an expert at bridge.

Dr. Putts will be remembered in Northwestern Pennsylvania as a practical consultant in general radiology. As such, he had much to do with firmly establishing his specialty in the basic framework of medical practice in that area. He was always a critical observer and throughout his lifetime kept fully abreast of the changes in related aspects of clinical medical practice.

RALPH D. BACON, M.D.

GILBERT CECIL LECHENGER, M.D.

1887–1951

Dr. Gilbert C. Lechenger, who for many years practised radiology in Houston, Texas, died in that city on Nov. 26, 1951. Dr. Lechenger was born in Houston on July 18, 1887. He attended the University of Texas, received his medical degree from the College of Physicians and Surgeons, Columbia University, and served his internship at Bellevue Hospital. He taught radiology for some years in the University of Texas and subsequently at Baylor University College of Medicine, where he was Emeritus Professor at the time of his death. He had served as head of the department of radiology at Hermann Hospital and Jefferson Davis Hospital, Houston.

Dr. Lechenger had been a member of the Radiological Society of North America since 1934.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, John B. Hamilton, M.D., 210 N. Central Ave., Glendale 3. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, G. A. Fricker, Sacramento Co. Hospital, Sacramento 17. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, Rex Uncapher, M.D., 7720 Girard Ave., La Jolla. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Ford Shepherd, M.D., 526 Soquel Ave., Santa Cruz. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Charles E. Duisenberg, M.D., Palo Alto Clinic, 300 Homer Ave., Palo Alto. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Wendell P. Stampfli, M.D., 1933 Pearl St., Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, U. V. Wilcox, M.D., 915 19th St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nelson T. Pearson, M.D., 1109 Huntington Bldg., Miami. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, Maurice Greenfield, M.D., Ingraham Bldg., Miami. Meets monthly, third Wednesday, 8:00 P.M., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Dudley King, M.D., 35 Linden Ave., N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Americus. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Willard C. Smullen, M.D., St. Mary's Hospital, Decatur.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Charles M. White, M.D., 3244 East Douglas, Wichita 8. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Richard B. Hanchett, M.D., 705-6, Medical Arts Bldg., Baltimore 1. Meets third Tuesday, September to May.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 621 High St., Jackson 2, Miss. Meets monthly, third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Francis O. Trotter, Jr., M.D., 634 North Grand Blvd., St. Louis 3. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell W. Blanchard, M.D., 1216 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, L. L. Robbins, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meets quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Nicholas G. Demy, M.D., 912 Prospect Ave., Plainfield. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meets in January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to May, at 8:45 P.M., Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Irving Schwartz, M.D., 45 E. 66th St., New York 21.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets at University Club, Albany, second Wednesday, October, November, and March. Annual meeting in June.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, George Gamsu, M.D., 191 S. Goodman St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary*, Walter J. Brown, M.D., Northern Westchester Hospital, Mount Kisco, N. Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, P. H. Woutat, M.D., 322 Demers Ave., Grand Forks.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Willis S. Peck, M.D., 1838 Parkwood Ave., Toledo 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Lee S. Rosenberg, M.D., Jewish Hospital, Cincinnati 29. Meets first Monday, October through May.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., 1037 Stuart Bldg., Lincoln, Nebr.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Henry E. Plenge, M.D., 855 N. Church St., Spartanburg. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, John E. Whiteleather, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Frank M. Windrow, M.D., 1205 Hermann Professional Bldg.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John N. Burkey, M.D., 555 Medical-Dental Bldg., Seattle. Meets fourth Monday, September through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee. Meets in May and with State Medical Society, September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving I. Cowan, M.D., 425 East Wisconsin Ave., Milwaukee 2.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, Jean Bouchard, M.D. Assoc. Hon. Secretary-Treasurer, D. L. McRae, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 26, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPÍA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, Mexico, D.F. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

PUERTO RICO

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542 Santurce, Puerto Rico.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive System

Hernia

The Musculoskeletal System

Gynecology and Obstetrics

The Genito-Urinary System

The Blood Vessels

Miscellaneous

RADIOTHERAPY

RADIOISOTOPES

EFFECTS OF RADIATION

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

An Improved Technic for Percutaneous Cerebral Angiography: A Preliminary Report. Dan C. Donald, Jr., Karl F. Kesmodel, Jr., Stacy L. Rollins, Jr., and Richard M. Paddison. Arch. Neurol. & Psychiat. **65:** 508–510, April 1951.

For cerebral angiography the authors use percutaneous puncture with a specially designed Huber point needle under local anesthesia. This point is said to be less traumatic than an open bevel point, while the hub plate of the needle permits greater control. After successful arterial puncture, a small radiopaque catheter is threaded through the needle up the internal carotid artery. Under fluoroscopic control, the catheter is advanced and the needle is then withdrawn. With the catheter tip just proximal to the carotid sinus, arteriography can be done with smaller amounts of thorotrast or diodrast, since there is less dilution. Inasmuch as there is no danger of puncture, the head may be moved safely with the catheter in place. This technic had been used in 7 cases, with satisfactory results.

Two roentgenograms; 1 photograph.

GEORGE R. KRAUSE, M.D.
Cleveland, Ohio

Notes on the Collateral Cerebral Circulation as Demonstrated by Carotid Angiography. A. Torkildsen and K. Koppang. J. Neurosurg. **8:** 269–278, May 1951.

In the normal living person, the blood stream through the internal carotid artery on either side proceeds to the homolateral hemisphere and only a small amount, if any, intermingles with the blood flow from the internal carotid on the opposite side. Partial or total obliteration of the internal carotid artery on one side, however, may be followed by a compensatory supply of arterial blood from the patent internal carotid artery on the opposite side. In cases of insufficiency of the communicating arteries, many neurosurgeons have seen the development of disastrous clinical conditions, such as hemiplegia or even death, following ligation of the internal carotid artery. In cases where this procedure is contemplated, valuable prognostic information may be obtained by carotid angiography, which readily discloses to what extent one hemisphere may be supplied by arterial blood from the carotid on the opposite side.

The authors attempt here to demonstrate the collateral circulation called into activity upon obliteration of the internal carotid artery at different points along its course. In cases of partial or complete obstruction of one internal carotid artery, the arteriograms show that the blood from the internal carotid artery on the healthy side not only proceeds to the pathological hemisphere by means of the circle of Willis, but also blood containing the contrast medium may descend into the internal carotid artery on the pathological side. It is assumed by the authors that in such cases the blood flows in a caudal direction through the carotid siphon.

In cases of bilateral occlusion of the internal carotid arteries, arterial blood may reach the cerebral hemispheres by means of the basilar artery.

In addition to the collateral circulation that may be derived from the circle of Willis, there are anastomoses between the external and internal carotid arteries. These consists of (1) branches from the external maxillary artery which connect with the branches of the ophthalmic artery by way of the angular artery, (2) branches from the ophthalmic artery connecting with branches of the temporal artery by the way of the supraorbital artery, and (3) intracranial arterial branches of the middle meningeal artery anastomosing with branches from both the lacrimal and the nasociliary arteries, which arise from the ophthalmic artery.

From angiographic experiences, it has been learned that in cases of gradual or sudden development of hemiplegia, the diagnosis of carotid thrombosis should be suspected, and angiography should be performed.

Fifteen roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

Deliberate Thrombosis of Intracranial Arterial Aneurism by Partial Occlusion of the Carotid Artery with Arteriographic Control. Preliminary Report of a Case. Arthur Ecker and Paul Riemenschneider. J. Neurosurg **8:** 348–353, May 1951.

Accepted methods of treatment of intracranial arterial aneurysms consist of bed rest, carotid ligation, and direct surgical attack. In general, the best results with aneurysms below the circle of Willis have been obtained by carotid ligation. The ideal result, it is believed, would be obtained if a thrombosis of the aneurysm were produced without impairment of the circulation through the parent artery. The authors present a case in which this was accomplished by partial occlusion of the common carotid artery in the neck.

The patient was a male who had headaches of two years duration. He had a spontaneous subarachnoid hemorrhage, after which angiography was performed. This revealed a sessile aneurysm of the left internal carotid artery just below its bifurcation. Bed rest for five weeks had no effect on the aneurysm. The carotid artery was compressed digitally for one hour, after which angiography revealed no change. A partial occlusion of the left common carotid artery was produced by means of a tantalum clip. The pressure in the common carotid artery was 61 mm. of mercury before the vessel was occluded. After the tantalum clip had been applied, the pressure was reduced to 51 mm. Subsequent carotid angiograms showed good filling of the internal carotid artery and its branches. The contrast medium was seen in the most anterior-inferior portion of the aneurysm. Films made both in the dependent and lateral projections showed no filling of approximately 80 per cent of the aneurysm. The angiograms were repeated one month later and revealed excellent filling of the internal carotid artery and its branches. For the first time, the left posterior communicating and left posterior cerebral arteries were filled. There was no definite evidence of residual aneurysm.

Eight roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

Encephalography in Cerebral Atrophy. Erik Lindgren. Acta radiol. **35:** 277–291, April 1951.

A decrease in the volume of a particular area of the brain is accompanied by a corresponding increase in the

adjacent part of the subarachnoid space or of the ventricular system. For the encephalographic demonstration of such changes, the author stresses the importance of an intimate knowledge of neurodiagnostic technic. It is essential, also, to be able to differentiate between normal and abnormal appearances. Actual measurements on an anteroposterior film are not adequate for this purpose. Account must also be taken of the shape of the ventricle and the amount of air introduced and its distribution.

The shape of the lateral ventricles is to a large extent related to the shape of the skull. Thus, in a short, high skull they are more convex than in a skull which is long and low. The width also varies with the width of the skull. Usually the width of the lateral ventricle may be said to be one-third of the distance between the midline and the lateral wall of the skull.

Proper manipulation of the head following introduction of air will at times prevent one from making an erroneous statement as to the difference in size of the two lateral ventricles. False impressions of enlargement of one or the other lateral ventricle may arise because the septum pellucidum apparently bulges into the opposite ventricle. Redistribution of the air by manipulation may disclose the source of such septum displacement.

Another technical factor to be taken into consideration is the interval between air injection and the taking of the films. The lateral ventricles may show an increase in width up to 7 mm. if a film is made twenty-four hours following air injection.

Consideration must be given to all these factors before concluding that cerebral atrophy is or is not present.

The author describes the changes found in cortical atrophy due to arteriovenous aneurysm (localized atrophy), general paresis (generalized cortical atrophy), and cerebral atrophy subsequent to a depressed fracture. In his experience, 30 per cent of cases of arteriovenous aneurysms may show localized cerebral atrophy and more than one-half of the patients with severe cranial and cerebral trauma may likewise show encephalographic change.

The subarachnoid spaces are best demonstrated by injecting 5 to 10 c.c. of air and holding the head in a position which will insure the passage of the air into these spaces. Characteristically, in such a situation the air will localize in the most atrophied area.

Forty-two roentgenograms. I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Calcifications in the Track of the Needle Following Ventricular Puncture. Bengt Falk. Acta radiol. **35**: 304–308, April 1951.

The complications which have been described as following ventriculography are (*a*) bleeding, either intracerebral or extracerebral, and (*b*) increased intracranial pressure. A later complication is calcification at the site of the burr-hole or along the track of the needle. There may be a string of calcific deposits along the needle track, usually about a millimeter in diameter, or the calcifications may be arranged in clusters measuring up to 1 cm. in diameter.

In the author's experience, 27 (13.3 per cent) of a series of 203 patients examined from one month to fifteen years after ventriculography displayed such calcifications. Six months was the shortest interval before the appearance of calcifications. It is conjectured that both types are the result of bleeding at the burr hole and along the needle track.

Five roentgenograms; 1 photograph.

I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Deaths Related to Pneumoencephalography During a Six Year Period. John R. Whittier. Arch. Neurol. & Psychiat. **65**: 463–471, April 1951.

Twenty-four deaths were found in a review of 2,490 pneumoencephalographic studies performed at the Neurologic Institute of New York between 1943 and 1949. In only 6 instances was the fatality considered to be related to the pneumoencephalography, on the basis of an uninterrupted deterioration in the clinical condition after the procedure. The remaining deaths occurred weeks or months later or followed intercurrent disease.

The 6 cases, which are reported at some length, represented 0.24 per cent of the series of 2,490 cases. All of these patients had large space-occupying masses. Five of them were cellular neoplasms, the other was a vascular lesion, presumably also a neoplasm. Five of the 6 lesions were supracallosal; one was located in the temporal lobe. In 4 of the 6 cases there was evidence of increased intracranial pressure.

The author recommends that in those instances in which clinical evidence supports a diagnosis of space-occupying intracranial lesion, probably large and supracallosal or temporal in location, ventriculography or arteriography should be the procedure of choice. Pneumoencephalography should not be elected unless the patient has been prepared for immediate surgical treatment.

Six tables. GEORGE R. KRAUSE, M.D.
Cleveland, Ohio

An Evaluation of the Technic and Results of the Radioactive Di-iodo-fluorescein Test for the Localization of Intracranial Lesions. Moses Ashkenazy, Loyal Davis, and John Martin. J. Neurosurg. **8**: 300–314, May 1951.

Radioactive di-iodo-fluorescein has been utilized in the study of 340 patients with a diagnosis of a space-occupying lesion of the central nervous system.

The radiation detection equipment consists of: (1) an end-window Geiger-Müller tube; (2) a tube shield and allied mount; (3) an electronic indicator, scaler, or counting rate meter; (4) a mechanical or graphic recorder. The tube sensitive diameter is 2.5 cm. The active detection area is found to be 1.2 cm. below the mica window. The tube shield usually employed has a lead thickness of 1.2 cm. It extends 1.2 cm. beyond the end of the tube, inscribing a solid angle of almost 2π.

An intravenous injection of 1 to 1.2 mc. of stable radioactive di-iodo-fluorescein is given into the antecubital vein. The Geiger-Müller tube is then placed in the inferior anterior temporal area and is kept there until the counts reach a plateau. The time may vary from fifteen to forty minutes. The following different positions are then surveyed, covering every area of the skull on and above Reid's base line, if the 2-in. diameter tube is used: 13 symmetrical positions on either side of the skull, 2 prefrontal, 3 frontal, 3 central, 3 parietal, 1 occipital, and 1 suboccipital. Six midline positions also are routinely surveyed. These include mid-prefrontal, mid-frontal, mid-central, mid-parietal,

mid-occipital, and mid-suboccipital areas. The tube is placed directly on the scalp and is maintained "normal" to the skull, that is, at right angles to the tangent at the particular position. Readings are of at least three minutes duration over each site, and are repeated over abnormal areas at frequent intervals of time from twenty minutes to four hours after injection of the dye.

Readings should be made as simultaneously as possible over symmetrically chosen areas. This is particularly important in the presence of a relatively acellular or avascular lesion, such as an astrocytoma or calcified oligodendroglioma. In these instances, the differences are only between 40 to 90 counts per minute (normal permissible difference 20–40 counts per minute).

The affinity of radiodye for tumor tissue is related to cellularity and vascular pattern of the tumor. The more malignant the neoplasm, the greater is the radiofluorescein concentration.

In 340 patients suspected of having central nervous system tumors, there were only 17 proved inaccuracies, making a total accuracy of 95 per cent. Localization was found to be much more precise than with electroencephalography or with pneumography, when verification was obtained at surgery or autopsy.

The negative findings also proved to be 95 per cent accurate and were of equal importance in the differential diagnosis of space-occupying lesions from nonsurgical lesions of the central nervous system.

Ten figures. HOWARD L. STEINBACH, M.D.
University of California

Intracranial Tumors Simulating Vascular Lesions of the Brain. A Preliminary Report. David Hartson. California Med. **74:** 253–255, April 1951.

The author presents the histories of 8 patients having intracranial tumors which simulated vascular lesions. The series included 7 gliomas and 1 metastatic tumor of undetermined origin. The vascular lesions simulated were meningovascular syphilis, subdural hematoma, carotid artery thrombosis with impaired cerebral circulation, hemorrhage into the thalamus, and thrombosis of the middle cerebral artery or its branches. The author quotes Rabiner (M. Times, New York **68:** 455, 1940) as calling attention to "piecemeal" hemiplegia, involving first one limb, then spreading to the face and the opposite limb, as suggestive of a neoplasm rather than of a true cerebrovascular accident. One of the reported cases showed this feature. Four of the patients in the series were over sixty-two years old and 4 were less than fifty-five; 2 were only thirty-one.

While these are selected cases, they are unusual examples in which papilledema and increased cerebrospinal fluid pressure were conspicuously absent, even though one patient was observed for as long as eighteen months. In all but 2 of the series ventriculographic studies furnished final and conclusive proof of the nature and localization of the tumor. This procedure should not be postponed unnecessarily.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Brain Tumor with Normal Air Encephalography and Arteriography. Report of an Unusual Case. W. Blackwood, William H. Mosberg, Jr., and P. K. Robinson. J. Neurosurg. **8:** 322–327, May 1951.

A case is reported of a brain tumor which produced hemiparesis, hemi-hypesthesia, and dysphagia, but in which carotid arteriography and air encephalography disclosed no abnormality and necropsy revealed no displacement of the ventricular system. The tumor was a glioblastoma multiforme which had infiltrated the cortical gray matter extensively and produced widespread dysfunction with little distortion of the gross appearance of the cerebrum. This case emphasizes the fact that a glioma may kill its host without producing pathological changes demonstrable by the ancillary methods of investigation in use today. The most constant diagnostic feature in the natural history of such tumors remains a relentless progressive course.

Two roentgenograms; 6 photographs.

HOWARD L. STEINBACH, M.D.
University of California

Radiological and Pathological Aspects of Tuberous Sclerosis, With Special Reference to Hydrocephalus. David Sutton and L. A. Liversedge. J. Faculty Radiologists **2:** 224–234, January 1951.

Besides unique clinical and pathological aspects, tuberous sclerosis presents many radiologic features of special interest. The authors reviewed the literature and summarize the x-ray findings previously described in cases of tuberous sclerosis as follows:

The Skull: (1) *Plain roentgenogram:* (*a*) intracranial calcifications (not seen in infants); small discrete nodules (almost diagnostic if multiple); large rounded calcifications (occasionally single); rarely, irregular sinuous calcifications; (*b*) mottling of the vault (not seen before puberty); (*c*) evidence of increased intracranial pressure. (2) *Pneumography:* (*a*) intraventricular tumors—"candle guttering" and multiple intraventricular nodules (diagnostic); single large tumors usually arising from the basal ganglia region; obstructive hydrocephalus may complicate either of the preceding; (*b*) evidence of generalized atrophy.

The Limbs: Hands and feet: cyst formation; periosteal thickening; osteoporosis. Long bones: fibrocystic changes; small periosteal nodules.

The Lungs: Generalized cystic change giving rise to "honeycomb lung" which radiologically resembles a miliary infiltration. Possibly large cysts.

The Renal Tract: Evidence of renal tumor either on plain film or pyelography.

Two cases of tuberous sclerosis are presented with a report of the clinical, radiologic, and necropsy findings. Both cases showed hydrocephalus on ventriculography. In one case the hydrocephalus was due to obstruction of the foramen of Monro by paraventricular "candle gutterings." In the other case, which had smaller ventricular "candle gutterings," the hydrocephalus with an associated florid papilledema was due to blockage of the foramina of Monro by a single "tumor" arising in the region of the right foramen and extending across the third ventricle.

Roentgenograms of the chest were normal in both of the authors' cases and there was no gross or microscopic evidence of pulmonary abnormality.

Althouth there was no roentgen evidence of cardiac enlargement or other change, the younger patient (aged 1 year 7 months) had multiple nodules in the wall of the heart and in the papillary muscles. The histologic appearance was that of the so-called "rhabdomyomata." In the heart of the older boy (14 years) there was no sign of such nodules but there were, within the myocardium of the left ventricle, three or four grayish-white areas, which to the naked eye re-

sembled fat deposition. Histologic examination revealed that they were made up of fibrous tissue surrounding large vacuolated spaces. Some of these contained cells similar to those seen in the frank "rhabdomyomata" of the younger patient. Two points are of interest concerning these findings. The first is that they suggest that these rhabdomyomata are not true tumors but are dysplasias of heart tissue which tend to undergo regression and diminution, and do not increase in size. The second point, which follows from this, is that clinically detectable cardiac abnormality is unlikely to result from small nodules which tend to become even smaller as life proceeds.

The pathological findings in the kidneys were similar to those in the heart. The "tumors" which were present in the younger patient were for the most part areas of mesodermal metaplasia which only rarely develop into full tumors and usually regress to the condition seen in the older patient.

In their discussion, the authors state that the possibility of tuberous sclerosis must be borne in mind when ventriculography reveals an intraventricular tumor arising from the region of the head of the caudate nucleus or anterior part of the thalamus and obstructing the foramina of Monro. In the presence of "candle guttering," a positive diagnosis can be made without reservation, even though external stigmata and intracranial calcifications are entirely absent. Multiple discrete intracranial calcifications should at once suggest the diagnosis of tuberous sclerosis.

The authors regard tuberous sclerosis as a widespread dysplasia of both mesodermal and ectodermal tissues.

Four roentgenograms; 2 photographs; 2 photomicrographs.

Platybasia: Report of Ten Cases with Comments on Familial Tendency, a Special Diagnostic Sign, and the End Results of Operation. William Beecher Scoville and Irving Jerrold Sherman. Ann. Surg. **133:** 496–502, April 1951.

Platybasia is easily diagnosed by roentgen studies but is often missed simply because it is not looked for. A fundamental feature is the deformity of the foramen magnum and the invagination of the cervical spine into the cranial cavity, so much so that occasionally the first cervical vertebra is hidden within the foramen magnum. Although the anomaly is congenital in origin, symptoms generally first appear in the third to fifth decade of life; extremes of four years and seventy-nine years of age have been reported.

Ten cases are presented here, all but 3 of which were seen in a two-year period in the neurosurgical practice of one man. Eight of the 10 cases were diagnosed as multiple sclerosis or syringomyelia over long periods of time by competent neurologists.

As far as the authors could ascertain, no previous mention has been made of a familial tendency. Two of the cases reported in this series occurred in sisters. Another patient, with platybasia, Arnold-Chiari syndrome, and syringomyelia, had a nephew with clinical syringobulbia and a possible platybasia and Arnold-Chiari syndrome. The mother of another had a short neck and a mildly unsteady gait. All but one of the series had other congenital defects: an Arnold-Chiari deformity in 8 cases; syringomyelia in 3; clubfeet in 1, and cervical ribs and Klippel-Feil anomaly, each in 1 case.

In addition to the neurologic signs of an ataxic gait, pyramidal tract signs, sensory changes, and squat neck, described in the literature, the authors stress a special sign observed in the majority of their cases. It consists of an atypical coarse type of nystagmus frequently occurring with the eyes in neutral position and changing its character or direction depending upon whether the eyes are turned laterally, upward, or at rest.

Myelography is of considerable aid in revealing the presence of constriction and an Arnold-Chiari deformity. If the patient's head is kept hyperextended, and under no circumstances rotated sideways nor the patient allowed to cough, 9 c.c. of pantopaque may be run up the spine and through the foramen magnum onto the clivus for a single anteroposterior spot film of the foramen magnum and then returned caudally without any residuum being left within the skull. Pneumoencephalography is a dangerous but confirmatory diagnostic aid, exhibiting an absence of filling of both the ventricular and basal cisternal systems accompanied by a marked physical reaction.

Surgical decompression will arrest progression but only occasionally improves the neurologic disability.

Two roentgenograms; 2 sketches.

BERT H. MALONE, M.D.
Jacksonville, Fla.

Craniolacunia Diagnosed Prenatally. Review of Literature with a Case Report. Generoso d'Aversa and Dudley H. Lonngren. Am. J. Roentgenol. **65:** 590–592, April 1951.

Craniolacunia was originally described by Hoffman in 1874 and cases have been sporadically reported since that time. Hartley and Burnett (Brit. J. Radiol. **17:** 110, 1944. Abst. in Radiology **44:** 91, 1945) reported an incidence of 0.94 per cent, which is higher than is generally held.

Since the condition is readily recognized by the roentgen appearance of large rounded areas of decreased density outlined by the web-like pattern of thicker bone, diagnosis should be simple. The frequent association of other congenital abnormalities, particularly meningocele, makes a prenatal diagnosis a significant factor in the conduct of delivery. The case reported showed multiple congenital abnormalities, including a meningocele, and the infant died on the fourth day of life. The associated anomalies in this case would tend to support the theory of developmental defect as an etiologic factor. However, in view of the mother's poor dietary regime, the theory of maternal malnutrition as a possible cause cannot be eliminated.

Careful search for fetal abnormalities is indicated in cases of craniolacunia diagnosed prenatally, since its occurrence alone is rare.

Two roentgenograms.

H. R. GRIFFITH, M.D.
Indiana University

Intracranial Calcification Following Pneumococcic Meningitis. Abraham Levinson and Hans Hartenstein. J. Pediat. **38:** 624–629, May 1951.

Cerebral calcification has been reported as a rare sequel to encephalitis lethargica, also following poliomyelitis and meningo-encephalitis. Camp (J. A. M. A. **137:** 1023, 1948. Abst. in Radiology **52:** 890, 1949) states that in the absence of associated encephalitis, calcification from meningitis *per se* is rare.

A case is here reported of intracranial calcification following pneumococcic meningitis in a two-month-

old Puerto Rican girl. Roentgenograms of the skull taken two weeks after admission to the hospital were normal. Films obtained seven months following the meningitis showed several large, irregular, mottled, calcific densities in the right temporoparietal region, with very small densities in other parts of the skull. There was overlapping of the bones at the sagittal plane, with cranial asymmetry. Pneumoencephalography revealed dilatation of the right lateral ventricle, multiloculated distribution of air in the left frontoparietal region, and calcific densities as previously described. Cerebral arteriography, when the patient was fourteen months of age, showed lack of filling of the middle cerebral artery distal to the bifurcation. This was interpreted as thrombosis of the middle cerebral artery with areas of encephalomalacia and calcification distal to the thrombosis.

The pathogenesis and the location of the calcification in this case cannot be definitely established. There are four possibilities: (1) thrombosis of the middle cerebral artery with encephalomalacia and subsequent calcification; (2) intracerebral calcification following meningitis without thrombosis; (3) subdural hematoma with subsequent calcification following meningitis; (4) calcification of the meninges following meningitis.

Six roentgenograms.

Pathogenesis of Ophthalmoplegic Migraine. Bernard J. Alpers and H. Edward Yaskin. Arch. Ophth. **45:** 555–566, May 1951.

The problem of the origin of ocular paralyses occurring in the course of migraine, referred to as ophthalmoplegic migraine, remains unsolved. Of the several concepts which have been proposed to explain them, that of cerebral aneurysm has received wide acceptance, though there has been little evidence to support it. In order to test the validity of the concept of cerebral aneurysm as a cause of ophthalmoplegic migraine, 2 patients with this condition were studied by means of arteriography. In neither instance was an aneurysm demonstrated.

Three arteriograms.

Orbitoethmoidal Osteoma. Byron G. McKibben and Ernest R. Casey, Jr. Arch. Otolaryng. **53:** 552–555, May 1951.

Osteoma of the orbito-ethmoidal region is not common. A case is reported in a 23-year-old male who complained of episodes of aching, burning, and swelling in the left eye. The left eyelids were moderately inflamed but soft. The conjunctiva was edematous and bulged over the lid margin temporally. Roentgen examination revealed a large, irregular mass, of hard bony density, measuring 2.0 by 2.5 cm. in diameter, in the left ethmoid labyrinth area, extending into the medial posterior portion of the orbit.

Complete recovery followed removal of the tumor. The microscopic diagnosis was fibro-osteoma.

Two roentgenograms; 5 photographs.

Malignant Tumours of the Upper Jaw. G. S. Seed. J. Faculty Radiologists **2:** 263–271, April 1951.

A review is presented of 75 cases of malignant tumors of the upper jaw treated in the Radiotherapy Department of the Leeds General Hospital (England). The clinical features are discussed at length, with a brief paragraph on roentgen observations. There is usually a diffuse opacity of the maxillary antrum, without a fluid level, in the roentgenogram of a patient with a carcinoma of the upper jaw. Erosion may be seen and can be demonstrated by a dental radiograph. Lipiodol injection into the antrum may be useful to outline an early growth, or a radiograph taken after an antral wash-out may help because a malignant growth may be accompanied by suppuration in the antrum. Exploration of the antrum usually gives a blood-stained fluid return.

Treatment is not discussed.

Four roentgenograms; 15 photographs.

THE CHEST

Clinical Physiology of the Human Bronchi. III. Effect of Vagus Section on the Cough Reflex, Bronchial Caliber, and Clearance of Bronchial Secretions. Karl P. Klassen, Douglas R. Morton, and George M. Curtis. Surgery **29:** 483–490, April 1951.

Utilizing bronchoscopy, fluoroscopy, and bronchography, the authors studied the following aspects of the clinical physiology of the human bronchi in a group of 7 patients with inoperable bronchogenic cancer, each of whom had one vagus trunk transected above the pulmonary plexus and immediately below the origin of the corresponding laryngeal nerve: (1) pain of bronchial origin; (2) cough reflex; (3) bronchial caliber and movements; (4) clearance of the tracheobronchial tree. The following results were obtained:

The cough reflex arising from the homolateral bronchial tree was abolished in all patients. This finding appears to indicate that the afferent fibers transmitting bronchial impulses resulting in initiation of the cough reflex are carried by the homolateral vagus nerve.

In the majority of the patients pain of bronchial origin was abolished on the homolateral side. In 3 patients there was referral of pain to the contralateral anterior cervical region. These results suggest that the afferent fibers transmitting pain from the bronchial tree are carried by the homolateral vagus nerve. The findings in the 3 patients in whom pain was referred to the contralateral anterior cervical region support the theory that certain of the afferent fibers from the tracheobronchial tree are carried by the contralateral vagus.

Bronchograms made during inspiration and expiration revealed no effects upon the normal respiratory movements of the bronchi. Paralytic dilatation of the homolateral bronchi was not found following high unilateral vagotomy. Bronchospasm persisted even after bilateral vagotomy.

No gross changes were noted in the amount or in the consistency of the bronchial secretions. Likewise post-bronchography chest roentgenograms revealed no impairment of the tracheobronchial clearance of lipiodol.

Three roentgenograms; 1 table.

Bronchography with Métras' Catheters. Björn E. W. Nordenström and Uno A. T. Norlin. Acta radiol. **35:** 246–249, April 1951.

The authors feel that the necessity of preserving the cough reflex when using lipiodol as a bronchographic agent and the use of straight endotracheal catheters has added to the difficulty of obtaining satisfactory bronchograms in all instances. These objections are in part eliminated by a more complete endobronchial anesthesia and the use of Métras' catheters. Five of

these catheters are used. They are made of rubber and are designed to render them suitable for various parts of the bronchial tree: two for the upper lobes, one for the middle lobe and apical branch of the left lower lobe, and one for the lingula and the apical branch of the right lower lobe bronchus. There is also a catheter for the straight bronchi in the lower lobes.

The catheter is passed into the trachea and under fluoroscopic control is "introduced into the desired bronchus." The authors state that this is not difficult. The radiopaque tip of the catheter "is moved up and down and at the same time rotated in the region of the bronchial opening, whereupon it generally slips into the bronchus." The bronchus is then selectively filled.

[It would seem that this method offers advantages in some cases. The abstractor admires the fluoroscopic dexterity and facility of the authors.]

Eight roentgenograms. I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

The Chest Survey in a Large General Hospital. Harold C. Ochsner. Dis. of Chest **19**: 444–453, April 1951.

In the Methodist Hospital, Indianapolis, from which this report comes, three groups are examined by the photofluorographic method: inpatients, outpatients, and employees. The last group have pre-employment examinations and annual re-examinations. The outpatient group includes hospital visitors, small groups referred by the county tuberculosis association, prenatal and other pre-admission patients. The examination is made without having the patient disrobe. The report form follows the pattern of Hodges of Michigan, listing numerically the most frequent findings.

The difficulties of so placing the unit as to make the service available to the largest number of people are discussed fully. The first position tried—in the x-ray department—was thought unsatisfactory in that many inpatients were missed at the time of admission and could not be examined prior to discharge, and most outpatients were missed. Moving the unit to a new position close to the admission desk, in the lobby of the hospital, increased the number of examinations of outpatients as well as some inpatients that would have been missed previously. However, it made more difficult the filming of inpatients missed at admission time and added to the technical problems regarding operation of the unit. Certain patients will apparently be missed regardless of location—*i.e.*, traumatic cases, obstetrical patients in labor, patients too ill for transportation to the unit, children admitted for tonsillectomies, and those admitted during hours that the unit is not manned.

The physical construction of the hospital, as in the author's case, may be such that it is impossible to obtain the optimum number of survey examinations. Hospitals considering new construction should give serious consideration to the placing of the ambulance entrance, admitting department, registration office, photofluorographic unit, and x-ray department in reasonably close proximity. The author also notes that since there is usually a delay in getting patients admitted, it should be urged on the staff that patients make a special trip to the hospital for the survey film during this waiting period.

In a review of the charts of 352 patients for whom reexamination was requested on the basis of films classified "pulmonary lesion definite" or "pulmonary lesion questionable," 59, or 2.5 per cent of the total examined, were found to have pulmonary tuberculosis, in most cases inactive. There were four false positives in which the survey film indicated probable tuberculosis, but two of these had primary pulmonary carcinoma, and another atypical pneumonia. In questionable cases, re-examination disclosed 27 without significant abnormality, 7 cases of bronchiectasis, 3 of lung abscess, 8 of pulmonary metastases, 25 of passive congestion, 24 of pneumonia, and 10 lesions later proved to be primary carcinoma of the lung. The value of the method in eliciting cardiovascular pathology, often unsuspected, is emphasized.

BERNARD S. KALAYJIAN, M.D.
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Mass Radiography Findings in the Northamptonshire Boot and Shoe Industry, 1945–6. Alice Stewart and J. P. W. Hughes. Brit. M. J. **1**: 899–906, April 28, 1951.

This study is a comprehensive analysis of the roentgenographic findings in the mass chest survey of 18,660 workers in boot and shoe factories in Northamptonshire, England. Apparently no factor has been overlooked to make the final statistics completely valid. Ten statistical tables show the age and sex distribution of workers; incidence of tuberculous and non-tuberculous pulmonary diseases and of active and quiescent tuberculosis; radiologic classification of cases of active tuberculosis; factory size and occupational analyses. The details are discussed in the body of the paper.

In comparing boot and shoe workers with workers in other occupations in the same area, it was found that the former showed a higher incidence of newly discovered active disease. There were as many new cases in men as in women, though in other occupations women were chiefly affected. Both the attack and carrier rates were lowest in factories with fewer than 100 workers and highest in factories with over 600 workers. Studies also showed more workers per given space in large factories than in small ones.

To account for the high incidence of tuberculosis in the boot and shoe industry it is noted that most of the work is light and suits the requirements of the physically handicapped. Thus, persons previously notified as having quiescent tuberculosis are likely to seek out these jobs. Interestingly enough, the lowest rate of tuberculosis in the shoe industry was found among those doing the most strenuous work. The heavily populated workshops facilitate the transmission of airborne disease, thus accounting for the incidence of newly discovered active cases. There is no evidence that leather dust, in moderate concentration, produces pneumoconiosis.

From a clinical point of view, mass radiography surveys cannot be overrated. However, the authors note that "the present investigation does suggest that the potential contribution of mass radiography surveys to epidemiology is not only neglected but actually hampered by preoccupation with matters of clinical interest."

BERTRAM LEVIN, M.D.
Chicago, Ill.

Follow-Up Study of Lung-Cancer Suspects in a Mass Chest X-Ray Survey. Clarence L. Scamman. New England J. Med. **244**: 541–544, April 12, 1951.

The author discusses some of the aspects of pulmonary cancer arising from a mass chest x-ray survey

conducted in Boston from Sept. 15, 1949, to Feb. 1, 1950. During this time a total of 536,012 miniature films were obtained. Any significant abnormalities on the small films were rechecked by 14 × 17-inch films. Of 9,372 large films, 7,254 were classified as showing some type of thoracic abnormality. Of this group 398 were thought to be suggestive of cancer. On 55 of these final information was not available, but of the remaining 343 studied, a diagnosis of cancer was made in 76. Primary lung cancer was proved in 43 patients, and radical surgery was performed on 20.

The Cancer Society by means of medical social workers undertook follow-up studies of the 398 cancer suspects. The author gives the cost for this work as $4,035, or $53 per patient for the 76 patients in whom a diagnosis of cancer was made. This figure does not include any of the costs of the mass survey nor the costs of the diagnostic studies on the cancer suspects.

Three tables. DEAN W. GEHEBER, M.D.
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Lymphangitic Carcinomatosis of the Lungs: Six Case Reports and a Review of the Literature. Theodore E. Hauser and Arthur Steer. Ann. Int. Med. **34**: 881–898, April 1951.

It is relatively unusual to find diffuse lymphatic permeation of the lungs resulting from a primary carcinoma elsewhere. When this does occur, the pulmonary symptoms usually become the outstanding and frequently the only presenting complaint. In the past ten years, there have been 6 cases of lymphangitic carcinomatosis of the lungs at Fitzsimons Army Hospital.

Due to the bizarre clinical manifestations, lymphangitic carcinomatosis of the lungs often presents a difficult diagnostic problem. Symptoms referable to the primary neoplasm are frequently absent, even up to the time of death. In other patients symptoms due to the primary lesion are present but are masked by the pulmonary symptoms.

The most striking and constant finding in these patients is the severe dyspnea, which appears to be progressive and unrelenting. Cough occurs in about 60 per cent of the cases. Other signs and symptoms are a pleuritic type of chest pain, cyanosis, low-grade fever, weight loss, anorexia, and weakness.

Actually, the roentgenogram of the chest is often diagnostic, for it reveals a pattern of thin stringy lines with frequent interweaving, branching out from the hilus. With these roentgenographic findings and the above-mentioned symptoms, if miliary tuberculosis, fungous diseases, and occupational diseases can be ruled out, lymphangitic carcinomatosis of the lung should be suspected. Of all sites, the stomach should be the first investigated.

The method of spread of the neoplasm to the lymphatics of the lungs is probably by retrograde lymphatic permeation, with the tumor cells growing along the lymph channels. It has been suggested that the tumor spreads along the paraesophageal lymphatics, thence through the hilar anastomoses into lung parenchyma, as well as through a hematogenous route.

The patients consistently showed fibrosing perivascular, vascular, and pulmonary changes associated with the lymphangitic spread, of a degree sufficient to explain at least in part the clinical findings. It is believed that the pulmonary syndrome found in these patients is a result of all of these changes and that they are not found separately.

Six cases are reported.

Six roentgenograms; 2 photographs; 4 photomicrographs. STEPHEN N. TAGER, M.D.
Evansville, Ind.

Cystic Disease of the Lung. J. D. Murphy and J. D. Piver. Dis. of Chest **19**: 454–472, April 1951.

Cystic disease of the lung may be classified into four groups: (1) congenital cystic disease; (2) acquired pulmonary cysts of alveolar origin, including blebs, pneumatoceles, and bullae; (3) cystic bronchiectasis—congenital (?); (4) miscellaneous conditions, as true lung abscess, parasitic involvement, etc., not discussed here.

In *congenital cystic disease* the cysts may be small or large, single or multiple, unilocular or multilocular, and may involve one, two, or all lobes. They are usually easily differentiated from cystic bronchiectasis by microscopic study of the cyst wall. Communications with the bronchioles can always be demonstrated. These may be small and easily obstructed, with ensuing infection, sometimes producing ulceration and hemorrhage. Symptoms are dependent upon disturbances of pulmonary physiology with enlargement of the cysts, encroachment upon normal lung tissue, and the results of infection. These complications occur commonly from the first through the third decade of life. Hemoptysis, cough, moderate expectoration, dyspnea, wheezing, chest pain, cardiac palpitation, and repeated febrile attacks should arouse suspicion. Ordinary x-ray studies may establish the diagnosis if the cysts are visualized, but laminagraphic studies may be needed in questionable cases. When the cyst is very large, pneumothorax may be suggested, though the hilar shadows are never prominent and often are diminished. Aspiration of such a cyst to allow the remaining lung to re-expand and immediate re-examination may reveal the disease. Biopsy of the cyst wall is important in making the final diagnosis.

Of the *acquired pulmonary cysts*, blebs are collections of air which occur just beneath the pleura in the interlobular connective tissue, resulting from rupture of nearby alveoli, allowing the air to dissect along tissue planes. The air may reabsorb or may rupture through the pleura and produce pneumothorax or mediastinal emphysema. The etiology is not clear, particularly in the absence of emphysema. Unless spontaneous pneumothorax occurs, symptoms are usually minimal.

A *pneumatocele* is a hyperventilated cavity deep in the pulmonary tissue. It results when inflammatory changes in a small bronchus supplying an area of interstitial pneumonitis establish a check-valve mechanism. The resultant increased pressure and the infection aid in destruction of the intra-alveolar septa. Pneumatoceles may contain air, fluid, or both, and be difficult to differentiate from the true lung abscess. Secondary flare-up of the inflammatory condition often follows. Daily roentgen studies may show considerable variations in size and fluid content. The course is usually brief, with spontaneous subsidence.

In *emphysema*, fragmentation of intra-alveolar elastic tissue and rupture of septa are usually diffusely equal, but may be localized and produce a large cavity called a bulla. There is probably some obstruction to air leaving the cavity but it is intermittent, and increased pressure is transient. Bullae may be single or

multiple and sometimes communicate. There is no epithelial lining, connections with bronchi are poor, and infections are rare. There is a tendency toward progression of the disease, with increasing respiratory embarrassment and right heart overloading.

Cystic bronchiectasis probably originates as congenital sacculations of the bronchi. Localized infection and dilatation of the saccules follows. With repeated infection, cysts are formed which may reach 3 to 4 cm. in diameter. These usually occur in the lower lobes, and a large abnormally dilated bronchus is always found entering the cyst directly. This is easily shown by bronchography.

Since the treatment of these diseases is largely surgical, accurate location or mapping of the involved areas by careful radiographic studies is of great importance in arriving at a decision as to the operability of a given lesion. Bilateral disease does not preclude operative removal, provided sufficient normal lung to sustain life is available. In cases showing evidence of infection, more careful preoperative preparation is necessary.

Seven case reports of various types of cystic disease of the lung are presented. Operative procedures—removal of cysts and one lobectomy—led to good results in six instances. The seventh patient had general cystic bronchiectasis and emphysema, and was only temporarily improved.

Twelve radiographs; two photographs.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Congenital Pulmonary Stenosis. Post-operative Observations on Two Hundred and Fourteen Children. C. R. Leininger, Stanley Gibson, and Willis J. Potts. Am. J. Dis. Child. **81:** 465–470, April 1951.

This is an analysis of the results of surgery on the first 214 children operated upon for pulmonary stenosis, at Children's Memorial Hospital in Chicago. The preoperative diagnosis was tetralogy of Fallot in 199 cases and tricuspid atresia in 15 cases. An aortic pulmonary anastomosis was established in 177, a Blalock procedure was done in 21, and in 1 case a localized stenosis of the left pulmonary artery was resected. In 15 anastomosis was not done, being prevented in 12 cases by atresia of the pulmonary artery. Seven of these 15 patients died shortly after surgery.

Of the 199 patients in whom anastomosis was done, 18 died in the immediate postoperative period and one lost his life in an automobile accident. Of the remaining 180, 145 could be traced for periods varying from six to forty-two months. Eight died from various causes while under observation.

In general there was considerable improvement following operation. The average red blood cell count and hemoglobin level returned to the normal range. Paroxysmal dyspnea, present in 66 patients prior to surgery, was not observed afterwards. In most instances, the immediate postoperative lessening of cyanosis remained unchanged. The increase in exercise tolerance was encouraging in some cases, and in a few instances dramatic.

Roentgenographically the heart was found to be enlarged to some degree after surgery in all cases. Changes in the QRS complex may represent the beginning of left heart preponderance, compatible with the changes in physiology resulting from the surgical procedure.

The degree of response to surgery has varied with the individual case, and the authors have been unable to predict which patients will benefit most.

Two children had transposition of the great vessels and pulmonic stenosis. Both died after surgery. Because of the electrocardiographic findings in these two cases, the authors suggest that unless the QRS in lead III is tall and upright the diagnosis of tetralogy of Fallot should be seriously questioned.

Three tables.

GEORGE R. KRAUSE, M.D.
Cleveland, Ohio

Spontaneous Pneumothorax, the Result of a Ruptured Diaphragm Complicating Pneumoperitoneum. J. J. Repa and H. R. Jacobson. Am. Rev. Tuberc. **63:** 587–590, May 1951.

In a patient who had been receiving pneumoperitoneum for tuberculosis, rupture of the diaphragm was proved by thoracoscopy. A slit measuring 1 cm. in length was found in the posterolateral aspect of the right hemidiaphragm, and a pedunculated cyst-like mass measuring 2 cm. in diameter was present in the same area. Biopsy of the latter showed connective tissue and muscle fibers compatible with normal diaphragmatic tissue. The cyst had been observed in a roentgenogram taken about two weeks prior to the rupture, but had been interpreted as an emphysematous bleb. The patient experienced chest pain and dyspnea, and mild shock was noted on physical examination shortly after the rupture, which resulted in right-sided pneumothorax. Recovery followed appropriate treatment.

Three points of interest are emphasized by the authors, in all of which the case resembles one previously reported by Yannitelli *et al.* (Am. Rev. Tuberc. **60:** 794, 1949. Abst. in Radiology **55:** 771, 1950). First, the rupture did not occur immediately after a pneumoperitoneum refill. This was thought by the earlier writers to be due in part to development of the highest pressure differential between the thorax and abdomen some days following the refill. Second, the rupture presumably occurred during a period of unusual activity, *i.e.*, during leave of absence from the hospital. Third, the diaphragmatic rupture was preceded by roentgenographic changes indicative of bleb formation on the pleural surface of the diaphragm. The frequency of such blebs is not known, but the development of the changes in patients receiving pneumoperitoneum should warn of possible impending diaphragmatic rupture.

Four roentgenograms.

JOHN H. JUHL, M.D.
University of Wisconsin

Bronchial Adenoma in a Supernumerary Tracheal Lobe. Report of an Unusual Case. Isaac Epstein. J. Thoracic Surg. **21:** 362–369, April 1951.

A benign, bronchial ademoma of carcinoid type is described. Its origin was within a supernumerary lobe of the right lung.

For ten years the 32-year-old male patient had complained of right chest pain, cough, and blood-streaked sputum. The chest film was normal except for the right upper lung field, where a sharply demarcated area of increased density appeared medially along the mediastinal border from the apex to the anterior end of the second right rib. Bronchoscopy demonstrated a right upper lobe bronchus arising from the trachea slightly above the carina. It was stenotic, with edema.

Thoracotomy was done, with removal of a super-

numerary lobe which was almost totally occupied by well encapsulated tumor tissue. Bronchography, one month after surgery, demonstrated three separate and complete lobes on the right. The resected lobe was truly supernumerary.

Bronchial adenomas are ordinarily believed to be associated with other abnormalities of the lungs. This particular association has not been previously reported.

Six figures, including 3 roentgenograms.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Pulmonary Manifestations of Systemic Diseases. John W. Middleton. Dis. of Chest **19**: 473–480, April 1951.

The author considers here a number of systemic diseases which may give rise to pulmonary lesions.

In *scleroderma* there is progressive interalveolar sclerosis, collagen fibers replacing the normal elastic tissue. Alveolar walls may disintegrate, giving rise to a cyst-like condition. Radiographs show a diffuse granulation or mottling, particularly at the bases, extending well out to the periphery, but sparing the apices. There may be peripheral cystic changes.

In *lupus erythematosus* the pulmonary changes are not so frequent, though there may be a patchy to confluent pneumonic process, frequently complicated by secondary invaders. The radiographic appearance is not characteristic; it may simulate tuberculosis.

In *periarteritis nodosa* characteristic pulmonary changes may occur in as high as 29 per cent of cases. Microscopically there may be a perivascular pneumonia with similar lesions dissociated from the vessel changes. Granulomatous lesions have been noted. X-ray and physical findings are said to be variable and not diagnostic. Transitory pulmonary infiltrations similar to those of Loeffler's syndrome have been reported.

In *rheumatic fever*, pulmonic consolidation is commonly found postmortem, with many large cells resembling those of rheumatic granulomata. The existence of true rheumatic pneumonia is, however, still in some doubt. There is a characteristic pulmonary change consisting of alveolitis, marked congestion, edema, engorgement, and the formation of hyaline membranes. X-ray findings may be interpreted as intense congestion, edema, pneumonitis, infiltration, infarct, or pneumonia.

Pulmonary lesions in a case of *rheumatoid arthritis* have been reported as a fine reticulation throughout both lungs and evidence of a chronic bronchopulmonic lesion. At autopsy, nodules consistent with interstitial pneumonitis with terminal bronchopneumonia were found.

In *erythema nodosum*, there are often enlarged hilar nodes and occasionally slight pulmonary changes such as might be termed acute bronchitis. The changes may be indistinguishable from those of sarcoidosis.

Eight roentgenograms.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Erythema Nodosum: The Possible Significance of Associated Pulmonary Hilar Adenopathy. C. Clifford Johnson, Norbert O. Hanson, and C. Allen Good. Ann. Int. Med. **34**: 983–997, April 1951.

Erythema nodosum has been described as "a nonspecific inflammatory reaction of the skin to a variety of bacterial, toxic and chemical agents." It is an acute febrile illness with painful nodular erythematous lesions on the shins and forearms and joint pains and malaise. Hilar adenopathy is associated with the above signs in some cases, but has not been generally recognized as an accompaniment of the condition. The authors were led to investigate this feature of the disease when three cases with involvement of the hilar nodes were encountered at the Mayo Clinic in a period of four months. In each of these three instances both the cutaneous lesions and the thoracic findings disappeared while the patient was under observation.

Beginning with April 1948, records of the Mayo Clinic were reviewed in reverse chronological order until 100 cases had been obtained in which the dermatologic diagnosis of erythema nodosum was unequivocal and in which roentgenograms had been taken while cutaneous lesions had been present. These records were examined with respect to sex and age of patients, duration of symptoms, sedimentation rate, relationship to hilar adenopathy, symptoms usually associated with erythema nodosum, and possible causative agents. The series included 77 females and 23 males. Ages ranged from ten to seventy-three years. Of 11 patients subjected to a tuberculin test, 2 gave a positive reaction.

Roentgenologic examination of the thorax revealed hilar adenopathy in 9 cases, bilateral in 8. The 9 patients were between thirty-eight and sixty-one years of age; 7 were women. In 5 cases follow-up films were available, and in 4 of these the hilar enlargement had disappeared. In 3 of the 4 clearing was complete in a period of one to seven months from the time of the initial examination; in the fourth case the thoracic film was negative twenty months after the initial examination. The one patient with hilar changes still present seven months after the initial examination also had persisting cutaneous lesions.

With respect to preceding and associated diseases, 4 of the 9 patients had symptoms of an infection of the upper part of the respiratory tract prior to the appearance of erythema nodosum. One had diabetes, 1 had an alveolar antral fistula, and 3 had no prior disease, although 1 of these had sustained an emotional shock.

In the records of the 9 cases in which pulmonary hilar adenopathy was present, no disease process other than erythema nodosum could be found which might be the cause of the hilar enlargement. The authors believe that hilar enlargement may be an associated manifestation of erythema nodosum of non-specific etiology. Disappearance of the hilar enlargement probably may be anticipated as the erythema nodosum subsides.

The clinical and laboratory findings in 9 cases are fully presented in tabular form.

Four roentgenograms; 5 tables.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Pulmonary Changes in Fibrosis of the Pancreas. Thomas Rosendal. Acta radiol. **35**: 233–245, April 1951.

The histologic changes in fibrosis of the pancreas consist of blocking and dilatation of the small excretory pancreatic ducts and of the acini, atrophy of the glandular cells, and a diffuse formation of connective tissue without actual inflammatory changes. The islands of Langerhans remain unaffected. The absence of the

pancreatic enzymes—trypsin, lipase, and amylase—in the duodenal juice results in an increased viscosity of the meconium in the newborn child, and meconium ileus follows. Fibrosis of the pancreas may not manifest itself until some time after birth, in which event the stool is large and fatty, with a cheesy odor, abdominal distention is present, and the clinical picture closely resembles the celiac syndrome.

In the lungs, as in the pancreas, there is a change in the secretory mechanism, with plugging of the lesser bronchi and bronchioles by a viscous, thickened secretion. Respiratory symptoms usually dominate the clinical picture, and death is due to the pulmonary changes. By a valve action emphysema may develop peripheral to the bronchial obstruction; later atelectasis appears. Secondary infection usually results, giving rise to purulent bronchitis, development of small abscesses, and bronchopneumonia. Interstitial fibrosis may cause a further increase in the bronchiolar occlusion, with resultant bronchiectasis. These pathological changes in the lung usually lead to a pertussoid type of cough, dyspnea, and cyanosis. Similar pathological changes have also been found in the bile ducts, in the glands of the intestinal canal, and in the salivary glands.

The author cites two cases of fibrosis of the pancreas. In the first case, unilateral pulmonary emphysema and accentuated lung markings were the predominant roentgen findings. In the second patient, advanced changes were observed in both lung fields, characterized by emphysema, very large and dense hilar shadows, and a greatly diffused increase in the lung markings.

Both of these cases presented rather typical clinical and pathological findings. In both, the enzymes listed above were absent from the pancreatic secretion, there were changes in the stool, and respiratory difficulty was an outstanding symptom.

Seven roentgenograms; 3 photomicrographs.

I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Traumatic Chylothorax. The Roentgen Aspects of This Problem. Robert M. Lowman, Jack Hoogerhyde, Levin L. Waters, and Constance Grant. Am. J. Roentgenol. **65:** 529–546, April 1951.

In reporting a case of traumatic chylothorax, resulting from an injury to the upper chest and neck, the authors take the opportunity to survey the surgical anatomy and physiology of the thoracic duct. Under the stimulus of the complex features associated with chylothorax, studies were undertaken to determine if additional significant aids for the solution of these problems could be found.

The thoracic duct takes origin from the cisterna chyli and ascends into the mediastinum through the esophageal hiatus to enter the systemic venous circulation in the left subclavian vein near its junction with the internal jugular vein. It drains the lymphatics below the diaphragm and the deep lymphatics from the dorsal half of the chest wall. When it is joined by the bronchomediastinal subclavian and jugular trunks, it drains the remaining portion of the left half of the body above the diaphragm. The right thoracic duct drains the right side of the body above the diaphragm and a portion of the superior surface of the liver, and empties into the right subclavian vein.

Radiographic visualization of the thoracic duct was accomplished by introducing contrast medium into the duct just above the diaphragm in autopsied subjects. Many variations were encountered in its course and termination. Bifurcations of the duct, with the channels rejoining above, and cross anastomoses were found to serve as collateral lymph channels. The modes of collateral circulation are such as to permit ligation of the thoracic duct, which, *per se*, is not dangerous. The physiology of the lymphatic system and the physiopathological effects of interruption of the thoracic duct are outlined.

Traumatic chylothorax resulting from intrathoracic rupture of the duct is rare. Other than indirect trauma to the thoracic duct, the causes of escape of chyle include incidental injury from surgical procedures (*e.g.*, Smithwick procedure for hypertension, lobectomy, esophagectomy, gastric resection, or any entry into the posterior mediastinum), neoplasms, filarial parasites, and tuberculous nodes or scarring from tuberculosis. Spontaneous chylothorax is seen in infants.

A break in the thoracic duct most commonly results in leakage of chyle into the right pleural space; a left chylothorax is more commonly a result of injury to the duct near its termination. The symptoms produced result from the presence of fluid in the pleural space and the loss of essential fluid, lymph chyle. The features on the roentgenogram are not unlike those due to fluid in the pleural cavity from any source. The authors suggest routine postoperative roentgenograms of the chest in all patients following intrathoracic surgical procedures with attention devoted to the possibility of loss of lymph chyle if a falling serum protein and lymphocytic count are demonstrated.

The treatment of chylothorax consists of conservative measures unless a rapid pleural accumulation of chyle and emaciation require surgical intervention. Ligation of the thoracic duct is proposed as the procedure of choice, although successful repair of the duct and anastomosis with venous channels have been recently reported. The conservative treatment entails replacement of protein, fat, and fluid lost in the chyle, thoracentesis, and the prevention of respiratory and vascular collapse. Heretofore, ligation of the thoracic duct has been attended by a high mortality; the mortality rate without surgical procedures is 50 per cent.

Nine roentgenograms; 3 drawings.

J. W. WILSON, M.D.
Indiana University

Anomalies of the Pulmonary Vessels and Their Surgical Significance, with a Review of the Literature. Charles W. Findlay, Jr., and Herbert C. Maier. Surgery **29:** 604–641, April 1951.

Under the heading Recent Advances in Surgery, the authors present a statistical review of the literature on arterial communications between the greater and lesser circulations and comment on the significance of these anomalies. Illustrative cases are also reported. A bibliography of 96 references is appended.

Eight roentgenograms; 4 drawings; 9 tables.

An Anomaly of the Pulmonary Veins. A Case Study. Francis N. Cooke, John M. Evans, Albert D. Kistin, and Brian Blades. J. Thoracic Surg. **21:** 452–459, May 1951.

A persistent abnormal linear shadow paralleling the right cardiac border was observed in a 20-year-old

solider without physical limitations and with no cardiorespiratory symptoms. Bronchoscopy and bronchography showed some variation in the right lobar bronchi: the lower lobe bronchus divided into two branches of equal size, and two of the segmental bronchi arising from these appeared to be blocked or stenosed. On this basis, a diagnosis of segmental atelectasis was made and exploratory thoracotomy was undertaken.

Surgical exposure disclosed a large vein as the structure responsible for the abnormal radiographic paracardiac shadow. The vein proved to be the right inferior pulmonary vein which drained into the inferior vena cava after piercing the right diaphragm through the central tendon. In the region where bronchography suggested stenosed or occluded bronchial segments, blind pouches from otherwise normal bronchi could be palpated.

Postoperative studies included angiocardiography, cardiac catheterization, and bronchospirometry. These demonstrated a shunt of arterial blood *via* the anomalous pulmonary vein connection back into the systemic venous circulation. In consequence, one-fourth of the oxygenated blood returning from the lungs re-enters the right side of the heart and only three-fourths is available for transport of oxygen to the tissues. The patient, nevertheless, is capable of sustained effort, demonstrating clearly that the right heart is supplying the necessary volume of oxygenated blood despite the loss of 25 per cent *via* the shunt. The stroke-volume of the right ventricle is one-third greater than that of the left, leading to the assumption that the right ventricle has the larger capacity. This is borne out by the prominence of the right heart border visible on exploration and roentgenologically. No surgical interference was deemed necessary.

Six roengtenograms; 3 drawings.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

The Pulmonary Artery in Bronchiectasis. Walter G. Gobbel, Jr., Joseph Gordon, and George J. Digman. J. Thoracic Surg. **21**: 385–390, April 1951.

Bronchiectatic lung specimens from operating and autopsy rooms were studied radiographically. The pulmonary arteries were injected with iodized oil and studies of the large and small branches were made. Additional films were taken after introduction of contrast medium into the bronchi. This permitted correlation of the extent and location of bronchiectasis with the size and distribution of pulmonary artery branches.

In non-tuberculous bronchiectasis the pulmonary arterial pattern is normal. In other words, a bronchiectatic lobe is poorly ventilated but fully circulated. That accounts for the poor oxygen saturation noted in extensive bronchiectasis and the improved oxygen saturation after removal of the involved lobe.

The pulmonary arterial studies in tuberculosis present a different picture. Small branches are few, and large branches are irregular. The normal pattern is gone. Areas of fibrosis and caseation have few or no arterial branches. The absence of circulation in poorly ventilated areas is in accord with oxygen saturation studies which show normal arterial oxygen in pulmonary tuberculosis at rest.

Six roentgenograms; 1 chart.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Obstructive Emphysema with a Defect of the Anterior Mediastinum. Report of a Case. James E. Lewis and Willis J. Potts. J. Thoracic Surg. **21**: 438–443, May 1951.

A case of proved congenital absence of the anterior mediastinum is presented. The patient, a male infant, required emergency thoracotomy at four months because of dyspnea and cyanosis. The chest film showed right middle lobe emphysema of extreme degree. The other lobes of the right lung were atelectatic. The heart was shifted to the left and posteriorly. A large area of increased radiolucency between the heart and sternum represented the right middle lobe.

The enlarged, emphysematous middle lobe was removed surgically. Pathological study of the specimen revealed no cause for emphysema. Exploration showed a large anterior mediastinal defect, permitting clear visualization of the left lung from the right pleural cavity. The possible role of the anterior mediastinal defect in the pathogenesis of the middle lobe obstructive emphysema is discussed.

This is said to be the third proved published case of complete absence of the anterior mediastinum undoubtedly of congenital origin, though Ochsner, DeBakey, and Murray mentioned 9 cases reported prior to their study (Surgery **6**: 915, 1939), in which the condition was suspected.

Three roentgenograms; 1 photograph.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Mediastinal Emphysema Complicating Induction of Pneumoperitoneum. Maurice J. Small and R. E. Fremont. Am. Rev. Tuberc. **63**: 591–596, May 1951.

One hour after a pneumoperitoneum refill, a patient experienced inability to swallow food, slight substernal discomfort, and pain in the throat. Examination revealed a classical precordial systolic crunch, and a tentative diagnosis of mediastinal emphysema was made. Chest films and fluoroscopy showed gas in the mediastinum along the left upper cardiac border, and phonocardiographic tracings were typical of the findings reported by Hoffman, Pobirs, and Merliss (Am. Heart J. **26**: 686, 1943) and others in mediastinal emphysema.

The pathogenesis of mediastinal emphysema complicating pneumoperitoneum has been the subject of a number of reports. The authors feel that the gas under pressure in the peritoneal cavity ruptures through a weak portion of the peritoneum into the retroperitoneal space and thence proceeds along the large vessels into the mediastinum. With renewed interest in pneumoperitoneum, it is likely that more cases similar to the one reported here will be found. When the diagnosis is in doubt, a lateral film with the patient supine should be helpful in accentuating the gas shadow anteriorly beneath the sternum.

Four roentgenograms; one phonocardiographic tracing.

JOHN H. JUHL, M.D.
University of Wisconsin

Mediastinal Tumour Simulating Left Ventricular Enlargement. Diagnosis by Means of Angiocardiography. Giovanni Di Chiro. Acta radiol. **35**: 299–303, April 1951.

The author reports the case of a child in whom a chest roentgenogram at the age of two disclosed a wide,

massive opacity contiguous with the heart and extending into the lower portion of the left lung. The clinical picture was one of acute inflammatory respiratory disease. A follow-up film, after recovery, showed the opacity to be smaller. Its form and localization strongly suggested enlargement of the left ventricle, but there were no symptoms or signs referable to the cardiovascular system. Subsequent roentgenograms showed a persistence of the shadow.

At the age of five the left cardiac contour was shown to be rounded and markedly displaced to the left. Angiocardiography, however, failed to reveal enlargement or modification of the shape of the cardiac chambers.

The possibility of a tumor surrounding the heart, of the subepicardial fat, pleura, or diaphragm was considered, and surgical exploration was undertaken. This revealed a cystic lymphangioma surrounding the pericardial sac from the left aspect of the heart to the right mediastinal pleura.

Six roentgenograms demonstrating preoperative and angiocardiographic findings, and a postoperative film accompany the paper. I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Large Thymic Tumor Simulating Pericardial Effusion. Arthur Bernstein, Emanuel Klosk, Franklin Simon, and Henry A. Brodkin. Circulation **3**: 508–513, April 1951.

An unusual case is reported, in which a huge thymoma (2,810 gm.) surrounded the heart and produced the roentgen findings (including change in shape with change in position) of a pericardial effusion. The condition was discovered on a pre-employment film, and the patient was practically asymptomatic. Since no fluid could be aspirated, thoracotomy was performed.

The tumor was so large that it had to be removed in two stages but apparently little difficulty was encountered. Convalescence was marred by a collection of blood on the right side of the tumor bed. Aspiration was not complete, but with streptokinase the clots were dissolved and easily removed.

Four roentgenograms; 2 photographs; 1 photomicrograph; 2 electrocardiograms.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Heart Puncture in Man for Diodrast Visualization of the Ventricular Chambers and Great Arteries. I. Its Experimental and Anatomophysiological Bases and Technique. Elmo R. Ponsdomenech and Virgilio Beato Núñez. Am. Heart J. **41**: 643–650, May 1951.

After reading an article by Ravitch and Blalock (Arch. Surg. **58**: 463, 1949) on the recovery of 8 patients following bullet, knife and ice pick wounds, the authors concluded that direct puncture of the heart and the instillation of a contrast substance to demonstrate the heart chambers and large vessels would be practicable. They first tried the procedure on dogs. Injection of 20 c.c. of 0.75 per cent sodium chloride solution under 20 lb. pressure through a cannula directly introduced through the wall of either the right or left ventricle of an animal weighing 42 lb. produced no objective alteration in the size of these cavities. Withdrawal of the trocar was followed by the appearance of a drop of blood at the site of the puncture, but no bleeding.

Being satisfied that the procedure was harmless, the authors then tried it in 30 patients, making 45 punctures. They use a trocar measuring 5 1/2 inches in length, with an external diameter of 1.7 mm., and a lumen of 1.2 mm. The puncture is made through the paraxiphoid area. Electrocardiographic tracings are obtained before, during, and after the injection. A roentgenogram of the ventricular cavities, of the aorta, of the pulmonary arteries, and of the coronary arteries can be obtained by injecting 50 to 80 c.c. of diodrast under a pressure of 25 lb. into the right ventricle and 35 lb. into the left ventricle. This method the authors call "cardioangiography." There have been no untoward results.

Seven illustrations, including 2 roentgenograms.
HENRY K. TAYLOR, M.D.
New York, N. Y.

A New Angiocardiographic Sign of Patent Ductus Arteriosus. R. H. Goetz. Brit. Heart J. **13**: 242–246, April 1951.

A very keen observation is contributed in this article, giving us what should be an important sign of a patent ductus on the angiocardiogram, namely a filling defect in the opaque column of the main pulmonary artery produced by the stream of non-opacified blood emerging from the aorta by the way of the patent ductus. Since the pulmonary artery must be opacified and the aorta not, it follows that the defect will be visible only on the early films (of which there should be several, since it can be expected to be somewhat transient).

The author states that the defect is usually seen in the anteroposterior view as well as the left anterior oblique, but may be more definite in the latter.

The reproductions clearly illustrate this new finding and should be seen by anyone interested in angiocardiography.

Three roentgenograms; 3 drawings.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Electrocardiographic Changes During Angiocardiography. Eugene L. Horger, Charles T. Dotter, and Israel Steinberg. Am. Heart J. **41**: 651–655, May 1951.

Electrocardiographic tracings were obtained during angiocardiography in 16 patients receiving a total of 21 injections of diodrast (70 per cent) or neo-iopax (75 per cent), the object being to explore a possible mechanism of death following the procedure.

After 20 of the 21 injections there was an increase in heart rate, varying from 4 to 69 beats per minute. There were striking changes in the T waves and RT segments. These varied from a slight decrease in amplitude of the T wave to flattening and inversion of the waves with coving. These changes were present between ten and sixteen seconds following the injection, and disappeared in most cases within sixty seconds, though in a few instances several minutes were required for return to the preinjection form.

Following 9 of the injections, either auricular or ventricular premature contractions, or both, occurred.

These electrocardiographic changes are similar to those seen in acute coronary insufficiency. It seems reasonable to assume that the contrast substance produces some change in the coronary circulation with resulting myocardial anoxia, and that this may con-

ceivably contribute to death following the procedure. A further possible factor in death following angiocardiography, as suggested by this study, is the onset of an abnormal rhythm.

Three electrocardiograms.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Nutritional Heart Disease. A. D. Gillanders. Brit. Heart J. **13**: 177–196, April 1951.

A type of congestive heart failure due to malnutrition is here described which has not been previously reported in the literature. The paper comes from South Africa, and the observations are based on a series of 30 Bantu adults, though the disease is believed to occur in children as well. It did not respond to any medication but was relieved rather promptly by wholesome diet. After recovery some patients voluntarily submitted to a trial of their former dietary regime (highly refined corn flour, white bread, tea and sugar, with practically no meat, milk, or vegetables) and the clinical syndrome recurred. Other patients suffered relapses after discharge from the hospital and return to their old eating habits.

The clinical picture is one of extreme edema, including hydrarthrosis and hydrocele in some cases, orthopnea, enlargement of the heart and liver. On x-ray examination the heart was usually found to be grossly enlarged, globular in shape, and very inert fluoroscopically. Some cases showed pleural fluid; although the x-ray findings suggested the presence of pericardial fluid, no significant effusion was ever found upon aspiration or at autopsy. Beri-beri, myxedema, anemia, hypertension, etc., were carefully ruled out by clinical and laboratory studies.

Therapeutic trials were carried out with every medication which was thought might influence the condition, but a wholesome diet was the only effective therapy. Eight out of 30 patients seen died, either from irreversible heart failure or from pulmonary embolism.

Significant changes were found histologically in the liver, consisting of pigmentary cirrhosis with hemosiderin in the liver cells as well as the Kupffer cells. In some cases there were also fatty changes in the liver. This type of liver damage has been produced experimentally by the same type of diet upon which these patients had subsisted. The author believes that the liver damage, apparently irreversible, probably plays an important part in the condition. He is now conducting investigations into the question of the importance of essential amino acids, which may be lacking in the corn protein.

Twenty-two roentgenograms; 1 photomicrograph; 3 electrocardiograms; 5 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Tricuspid Atresia. Report of Three Cases and Evaluation of Diagnostic Criteria. Herbert L. Abrams and Robert H. Alway. Pediatrics **7**: 660–669, May 1951.

Congenital tricuspid atresia or stenosis is a cardiac anomaly consisting in absence of normal communication between the auricle and the right ventricle and failure of development of the latter. It is this failure of normal right ventricular development which should provide the clues leading to the antemortem recognition of the anomaly.

The literature of the past fourteen years was reviewed and 44 cases in which data were available are analyzed. In addition, 3 hitherto unreported cases of congenital atresia or stenosis are presented, in 1 of which the roentgenologic and electrocardiographic findings are noteworthy.

Clinical Findings: Cyanosis was generally present at birth and was persistent, although in a few instances it was not noted until after the neonatal period. Clubbing occurred in 13 cases. Murmurs were audible in 20 of 28 cases in which this feature was specifically mentioned. In all the murmurs were systolic, and in 1 case there was also a diastolic murmur.

Electrocardiographic Findings: Electrocardiograms were obtained in 39 of the cases reviewed. Left axis deviation was present in 36 of these.

Roentgenologic Findings: In 33 of the cases reviewed, roentgenograms were obtained.

Postero-anterior view: In most cases, the heart was either normal in size or only slightly enlarged. The apex was usually slightly elevated, but the elevation was not, as a rule, as striking as that in the tetralogy of Fallot. Furthermore, there was usually greater fullness of the lower left (left ventricular) cardiac border than is commonly seen in the tetralogy of Fallot. A moderate concavity of the pulmonary artery segment of the left upper cardiac border was noted. The pulmonary vascular markings were usually either diminished slightly or at the lower limits of normal. In some cases the presence of diminished blood flow to the lungs could not have been definitely determined on the basis of the roentgenogram. The "characteristic fine, mottled and reticulated pattern" in the lungs due to bronchial arterial anastomoses was not a prominent roentgenologic feature in the reported cases. In about one-third, a narrow mediastinal shadow was mentioned; in general, this does not appear to be an important diagnostic feature.

Left anterior oblique view: Taussig has stressed the fact that the presence of a small or rudimentary ventricle is suggested by failure of the heart border to project significantly anterior to the aortic shadow in the left anterior oblique view. She has pointed out that the left ventricular enlargement in this anomaly is expressed by the posterior displacement of the posterior cardiac border. In the reported cases, the left anterior oblique view was not utilized sufficiently to permit any definite conclusions.

Thus, except for the fact that the apex is somewhat lower and that there is somewhat greater fullness of the left lower cardiac border in the frontal projection, the roentgen appearance of tricuspid atresia in the postero-anterior view need not be strikingly dissimilar from that of the tetralogy of Fallot. The left anterior oblique view may give adequate evidence of the enlarged left ventricle and of absence of enlargement of the right ventricle.

Angiocardiography: With adequate studies, the diagnosis of tricuspid atresia should be made by the observation of sequential opacification of the right auricle, the left auricle, and the left ventricle. Cooley *et al.* (Radiology **54**: 848, 1950) have pointed out that the three findings of significance are: demonstration of a communication between the auricles, best shown in the frontal projection; non-visualization of the right ventricle, or visualization of a small right ventricle,

best shown in the lateral projection; demonstration of a large left ventricle, seen equally well in the frontal or lateral projection.

Cardiac Catheterization: Studies with intracardiac catheterization are not conclusive, although they may be highly suggestive. They demonstrate the presence of an interauricular septal defect and inability to catheterize the right ventricle.

That the classical roentgen findings are not always present was demonstrated by one of the authors' patients, a 5-week-old infant. The heart was massively enlarged in all projections. The pulmonary artery segment was not concave. The configuration of the heart in the postero-anterior view resembled that of transposition of the great vessels, with a strikingly narrow great vessel shadow, which failed to widen in the left anterior oblique view at fluoroscopy. This, in conjunction with the clear lung fields, made transposition an unlikely possibility. In the left anterior oblique view, not only was there no straightening of the anterior heart border, but it extended far anterior to the root of the aorta. Although it was thought that this represented in part an enlarged right auricle, the presence of right ventricular enlargement was suspected. The prominent extension of the posterior heart border behind the spine strongly suggested an enlarged left ventricle. Necropsy showed the portion of the heart projecting anterior to the aorta to be an enlarged right auricle and hypoplastic right ventricle. Thus, the prominence of the anterior heart border in relation to the ascending aorta proved to be misleading. This sign may be further misleading in that failure of the right ventricular shadow to project anterior to the aorta may also be noted in congenital cardiac anomalies in which right ventricular enlargement is present. When the aorta is anteriorly placed, as in complete transposition of the great vessels or in the presence of a right-sided aorta or of a dextroposed aorta, there may be smooth continuity of the aortic and right ventricular shadow, forming a relatively straight anterior border in the left anterior oblique view. In such situations, the chamber size of the right ventricle becomes more difficult to assess in this projection.

Angiography is most useful in cases which are atypical and in which the diagnosis is obscure. In the case described above, the region of the right ventricle was never opacified. The presence of early faint right auricular opacification suggested the diagnosis of tricuspid atresia. Electrocardiographic studies in this case showed no axis deviation.

Seven roentgenograms; 1 photograph.

Mitral Stenosis Without Clinically Demonstrable Left Auricular Enlargement. Sanford Pariser, Jack Zuckner, Henry K. Taylor, and William J. Messinger. Am. J. M. Sc. **221**: 431–439, April 1951.

Out of a series of 30 patients with necropsy evidence of mitral stenosis, for whom adequate roentgen studies were available, the authors found the surprising number of 6 without displacement of the esophagus, which is generally accepted as evidence of left auricular enlargement. In 2 of the 6 the auricle was found to be of normal size postmortem, but in the other 4 it was enlarged. Adhesions between the esophagus and aorta or an unusual course of the esophagus are the only explanations offered to account for the absence of the usual esophagraphic evidence. An additional 30 patients believed clinically to have mitral stenosis were examined, and 7 of these failed to show roentgen evidence of left auricular enlargement. Combining the two series, one finds that approximately 1 out of 4 patients with mitral stenosis failed to show displacement of the esophagus on x-ray examination. Failure to demonstrate enlargement of the left auricle roentgenologically should not, therefore, deter one from strongly suspecting the presence of mitral stenosis if other clinical signs are present.

Six roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Calcification of the Left Atrium. M. H. Fainsinger South African M. J. **25**: 233–234, April 7, 1951.

An unusual case of cardiac calcification is presented, in which the entire left atrium was outlined by calcium, following rheumatic fever. A mitral valvular lesion was also present. The patient was still living at the time of the report, so it was not known whether the calcification was in the myocardium, endocardium, or both. It definitely did not follow the parietal pericardium.

Three roentgenograms; 1 phonocardiogram.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

Congenital Short Esophagus. Review of Literature and Eight Original Cases, Including One Autopsy Report. William J. Sinclair. Arch. Surg. **62**: 557–564, April 1951.

The author briefly reviews 8 cases of "congenital short esophagus," including a detailed description of the history and autopsy findings of one case. This anomaly is no longer considered a rarity but its description in autopsy material is infrequent. Congenital short esophagus requires sharp distinction from hiatal hernia, since in the former the stomach has never occupied its normal position in the abdomen. The condition is demonstrable by roentgen examination and/or esophagoscopy.

In the author's series there were three deaths. In the one in which autopsy was performed, confirming the clinical and x-ray diagnosis, the esophagogastric junction was at the level of the seventh thoracic vertebra, which appears from the observations of others to be a remarkably consistent site. Dysphagia, pain, and vomiting in relation to eating were characteristic symptoms. Emotional stress has a definite relation to exacerbations and remissions of symptoms.

The primary objectives in therapy are the prevention of acid-peptic reflux and elimination of the mechanical complications of a displaced stomach. Uncomplicated cases are best managed by a medical regime. Complicated cases require surgical intervention. Replacement of the stomach in the abdomen is considered ideal, but when this is impossible, subtotal gastric resection appears most logical.

Four roentgenograms; 2 drawings.
ROBERT H. LEAMING, M.D.
Memorial Center, N. Y.

Congenital Tracheo-Esophageal Fistula Without Esophageal Atresia. James A. Helmsworth and Charles V. Pryles. J. Pediat. **38**: 610–617, May 1951.

A case of congenital tracheo-esophageal fistula without atresia in a 6-month-old boy is presented. This

diagnosis should be considered in all infants and children with paroxysms of coughing precipitated by intake of food, gaseous distention of the gastro-intestinal tract, and persistent or recurrent pneumonitis. In the case reported, roentgen examination on several occasions showed disseminated inflammatory changes in the lungs and marked gaseous distention throughout the gastro-intestinal tract. Endoscopic examination disclosed an apparently normal esophagus and only a moderate amount of mucopurulent material in the bronchial tree. A tracheo-esophageal fistula without esophageal atresia seemed the only possible diagnosis in spite of the fact that no fistula had been demonstrated roentgenographically, and none had been seen on bronchoscopy.

The patient made an uneventful recovery following operative closure of the fistula, and at the time of the report, at the age of thirteen months, was symptom-free.

Four roentgenograms; 2 drawings.

Preliminary Studies of the Gastrointestinal Tract with Colloidal Barium. Frank Windholz, Henry S. Kaplan, and Henry H. Jones. California Med. **74:** 155–160, March 1951.

A stable colloidal suspension of barium sulfate has been developed and is now available in two forms: a viscous concentrated suspension for examination of the upper gastro-intestinal tract and a less viscous, dilute suspension for opaque enemas.

After this medium had been in use in the Department of Radiology of Stanford University Hospitals, San Francisco, for about four months, the authors reviewed the films in a series of 208 cases, in 137 of which the colloidal barium had been administered and in 71 cases the usual barium mixture. The films were studied with reference to the following items: (1) recognition of the medium employed; (2) demonstration of the gastric mucosal pattern, filled stomach, filled and compressed duodenal bulb, mucosal pattern of small bowel, distribution and contours of small bowel, and degree of flocculation; (3) motility of the meal.

Roentgenograms made following colloidal barium administration were seldom mistaken for those obtained with conventional barium suspensions, but the converse occurred not infrequently, confusion of the two media being almost entirely confined to the cases in which ordinary barium-water mixtures had given relatively optimal results.

Both media gave satisfactory opacification of the filled stomach. Gastric mucosal folds were well demonstrated in a greater percentage of cases when the colloidal material was used, although visualization was unsatisfactory in 10 per cent of the cases even with this medium. The colloidal barium often yielded good mucosal patterns in the presence of retained gastric secretion. It tended to coat the gastric surface rather uniformly, and in the presence of air this property often afforded unusual demonstrations of the antrum and corpus in supine projections.

The relative merits of the two media in the duodenal bulb paralleled those in the stomach. The greater film-forming properties of the colloidal material were even more evident, a faint coating being consistently demonstrable on compression "spot" films.

In the small intestine, the colloidal suspension provided a pattern quite unlike that usually observed with barium and water mixtures. It formed a smooth uniform coating which outlined the walls and valvulae with great clarity. The tendency to maintain a single column was pronounced, and frequently the entire small bowel was clearly visualized on a single film. Flocculation and segmentation were minimal. Motility with the two media did not appear to differ significantly.

The new medium has not been used extensively for opaque enema studies of the colon because its advantageous qualities are minimized under these conditions and its greater viscosity delays filling. It has, however, yielded consistently superior results in double-contrast examination of the large bowel. These studies are described in RADIOLOGY (**56:** 561, April 1951).

Twelve roentgenograms; 3 tables.

Oral Banthine, an Effective Depressor of Gastrointestinal Motility. Michael J. Lepore, Ross Golden, and Charles A. Flood. Gastroenterology **17:** 551–559, April 1951.

Using the technic of Golden, the authors made an attempt to study radiographically the effect of banthine (B-diethyl amino ethyl xanthene-9-carboxylate methobromide) on gastro-intestinal motility.

"Transit time" studies were made in 7 patients—3 suffering from watery diarrhea without evidence of organic disease, and 4 with inflammatory lesions of the large or small bowel. An initial study showed rapid transit of the barium meal in 6 and hypomotility in 1. Following the administration of banthine the small-intestinal transit time was notably prolonged in the first 6 patients. The drug was without demonstrable effect in the patient originally showing hypomotility.

To eliminate psychologic and chance effects, the study was repeated with a placebo or 0.0006 gm. of atropine sulfate. These studies dramatized further the striking results of banthine, which in the positive instances prolonged transit time from three to nine hours over control times.

Two patients who had undergone vagotomy also showed prolongation of transit time following administration of banthine, suggesting that the drug exerts its effect upon the acetylcholine intrinsically elaborated in the intestine. In one of these patients a small bowel obstruction developed while banthine and metamucil were being administered.

The more common reactions consisted of mild paralytic ileus, which was encountered in several patients, and transient dryness of the mouth and dilatation of the pupil. The dosage of banthine was 100 mg. given orally thirty minutes before the examination.

Six roentgenograms; 1 table.

JOSEPH T. TOMSULA, M.D.
Baton Rouge, La.

Significance of Opaque Medications in the Gastro-intestinal Tract, with Special Reference to Enteric Coated Pills. C. L. Hinkel. Am. J. Roentgenol. **65:** 575–581, April 1951.

Opaque medications in the gastro-intestinal tract have long been a source of annoyance to the radiologist, enteric-coated capsules being the most frequent offender. The author reproduces roentgenograms showing just how confusing undissolved pills or tablets may be when projected through the kidneys, ureters, gallbladder, and urinary bladder. He is concerned chiefly, however, with the clinical significance of intact pills, capsules, and tablets in the lower small intestine

and large intestine, indicating failure of dissolution and thus accounting for absence of the expected therapeutic effect.

Pills remain undissolved either because of the inherent insolubility of the coating, especially as a result of aging and dehydration, or because of deficient dissolving power on the part of the patient, due to faulty digestive action. The author discusses at length the nature, standardization, and testing of enteric coatings and describes a simple solubility test. His appeal to the radiologist is to aid the clinician by pointing out the implications of these undissolved pills in the gastrointestinal tract.

Five roentgenograms. WM. H. SOMERS, M.D.
Indiana University

Cardiospasm Simulating Mediastinal Tumors. Herbert M. Perr. Am. Rev. Tuberc. **63**: 597–602, May 1951.

A patient with a long and somewhat indefinite history of respiratory infections had received antibiotics of various types, with prompt recovery on each occasion. Upon admission, the chest film revealed a right peritracheal mass with rather smooth lateral outline, in addition to two paravertebral soft-tissue masses which presented to the left of the spine at the level of the tenth thoracic vertebra and to the right at the level of the eleventh. This led to a tentative diagnosis of lymphoma. An esophagram revealed the true nature of the densities; the esophagus was dilated, elongated and tortuous as a result of long-standing cardiospasm. Careful review of the history uncovered a significant symptom which had been present for ten years. After swallowing solid food, the patient would experience a temporary sticking sensation in the mid-epigastrium which was relieved by hyperextension of the spine or upon drinking.

The author suggests that disease of the esophagus be considered in cases with unexplained respiratory symptoms.

Thirteen roentgenograms. JOHN H. JUHL, M.D.
University of Wisconsin

Cytologic and Radiologic Observations in Lymphosarcoma of the Stomach. Report of a Case. K. F. Ernst, Thomas T. Beeler, and Lewis A. Smith. California Med. **74**: 274–276, April 1951.

While over 600 examples of lymphosarcoma of the stomach have appeared in the literature, the authors believe that the cytologic findings and some of the radiologic features of their case justify this additional report.

The patient was a 31-year-old physician. Roentgen examination revealed a large ulcerating lesion on the posterior wall of the pars media, near the greater curvature, with enlargement of the gastric mucosal folds in the distal two-thirds of the stomach. Gastroscopic study confirmed these findings, and malignant cells were found in smears prepared from material obtained by gastric lavage. Gastrectomy was done and the pathologic diagnosis was lymphosarcoma of the stomach with regional lymph node involvement. Roentgen therapy was given postoperatively, but the outcome is not stated.

Roentgenograms show the enlarged mucosal folds and the superficial ulceration, Two photomicrographs and a photograph of the pathologic specimen are also included. S. F. THOMAS, M.D.
Palo Alto, Calif.

Gastrointestinal Roentgenographic Observations in Peptic Ulcer Patients Treated by Vagotomy. Charles A. Priviteri. Am. J. Roentgenol. **65**: 561–574, April 1951.

The author studied 47 cases of duodenal or marginal ulcers before and after treatment by vagotomy. All patients were males, and the age range was from twenty-one to fifty-eight years. The criteria for selection were as follows: chronic severe pain with or without melena but without active or acute hemorrhage; roentgen evidence of duodenal or jejunal ulcer without pyloric obstruction or gastric retention; poor response to prolonged medical treatment. Gastric ulcers were excluded.

In 40 cases of duodenal ulcer, results were considered excellent in 8, good in 19, and failures in 13 cases. In 7 cases of jejunal (marginal) ulcer, results were excellent in 3 cases and failures in 4. Patients were followed for an average of two years. Immediately after vagotomy ulcer symptoms subsided in only 36 cases. Melena disappeared in all but 1 case but subsequently reappeared in 7. All except 11 patients showed residual deformity of the duodenal bulb or non-visualization of the bulb one month postoperatively. Seven patients had persistent ulcers and 10 recurrent ulcers, accounting for the 17 failures.

Complications of vagotomy in this series included pleural effusion, 12 cases, hydropneumothorax 3 cases, segmental pneumonitis 1 case, segmental atelectasis 1 case, and pericardial effusion 1 case. All the above complications were associated with minimal or no symptoms. There were two deaths in the series, but both occurred after a second operation.

One of the most striking effects of vagotomy is gastric atony. In 75 per cent of the cases moderate to severe atony developed, and this finding was present in 26 per cent at the end of the third postoperative month. In these cases, re-establishment of normal gastric tonus required from six to eighteen months after vagotomy. Overnight gastric secretion dropped immediately after vagotomy from an average level of 970 to 290 c.c., and the free hydrochloric acid dropped from 44 to 23 units. During the next two years both of these values rose but neither reached normal. In the majority of patients in this series mucosal coarsening and segmentation of the small intestine developed. There was also a degree of delayed progression.

It is the author's opinion that treatment of peptic ulcers by vagotomy without concomitant gastroenterostomy is not superior to other methods of treatment.

Twenty-four roentgenograms; 6 tables.
W. L. BRIDGES, M.D.
Indiana University

Gastrojejunocolic Fistula Following Vagotomy for Marginal Ulcer. Benjamin F. Byrd, Jr. Gastroenterology **17**: 431–435, March 1951.

During the past four years the treatment of benign ulcers of the stomach, duodenum, and jejunum by resection of the vagus nerves has become extraordinarily popular, but the complications following the procedure have not been widely recognized or publicized.

The author presents the case histories of two patients in whom gastrojejunocolic fistulas developed following vagotomy for marginal ulcer. In each instance a transthoracic supradiaphragmatic resection of the vagus nerves was done with removal of segments measuring

7.5 cm. in one instance and 2 to 3 cm. in the other. In both patients insulin tests were carried out, the results of which were compatible with complete division of the vagal supply to the stomach.

Both of these patients had marked neuroses, and adequate clinical evaluation of their pain was impossible, but the x-ray evidence of ulceration was present and the subsequent fistula site was the same as that of the initial marginal ulcer.

A careful follow-up study on all cases of marginal ulcer treated by vagotomy is advised, since healing is not invariable, in spite of symptom-free periods.

Eight roentgenograms. HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Post-Bulbar Duodenal Ulceration. Warren M. Lonergan and Alfred Kahn, Jr. Gastroenterology **17**: 494–503, April 1951.

Peptic ulceration of the distal duodenum is a relatively uncommon lesion. The incidence has been variously reported as 5 per cent to 17 per cent of all duodenal ulcerations. Ten cases were found in 75,000 admissions to the Barnes Hospital (St. Louis, Mo.) in a period of seven years, and these are reported here.

The symptoms in general do not differ from those usually seen with other duodenal ulcers, pain being the most frequent complaint. Two variations may be of diagnostic aid: first, failure of recurrent pain to respond to adequate therapy; second, the too common story of recurring hemorrhage. Occasionally the pain may radiate to the mid back.

Diagnosis is made primarily by x-ray examination. A more complete roentgen study would lead to earlier diagnosis and prevent complications of a serious nature, as hemorrhage, perforation, and stenosis. A niche was demonstrated in one-half of the authors' cases. The second sign of importance, narrowing and constriction of the lumen, was present in all 10 cases. Duodenal diverticula present the most frequent problem in differential diagnosis.

Three roentgenograms.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Duodenal Obstruction in the Newborn. J. O. Rankin. West Virginia M. J. **47**: 107–113, April 1951.

Complete duodenal obstruction in the newborn is a rather rapidly fatal disease unless it is relieved early. Its occurrence has been estimated at 1 in 20,000. The mechanism may be intrinsic, *i.e.*, due to failure, during embryonal life, of transition of the solid pre-intestinal cord to a hollow tube, or extrinsic, *i.e.*, due to peritoneal bands, adhesions, anomalous blood vessels, torsion, or volvulus. The most important symptom is progressive vomiting. Constipation and extreme and rapid dehydration are present.

The vomitus may or may not be stained with bile, depending on the location of the obstruction. If it is distal to the ampulla of Vater, which is the rule, the vomitus will be bile-stained and the meconium acholic; with complete duodenal atresia or obstruction at the ampulla, both vomitus and meconium will be acholic and the patient will be jaundiced; obstruction proximal to the ampulla will produce an acholic vomitus and bile-stained meconium. There may be a palpable mass in the epigastrium, disappearing after vomiting, and peristalsis of the distended stomach and duodenum may be visible.

Abdominal films show fluid levels and gaseous distention of the stomach and duodenum. With complete obstruction, there is no gas distal to the duodenum. When a contrast medium is necessary for more definite conclusions, it is wise to inject a minimal amount of a thin solution of barium through a duodenal tube and then aspirate it as soon as the study is completed. Failure of the barium to pass the duodenum in six hours indicates duodenal atresia.

The treatment is surgical and should be instituted as soon as possible. Gastric decompression is necessary preoperatively and two or three days postoperatively. The prognosis is unfavorable because of the usually poor condition of the patients and the frequent coexistence of other anomalies.

Five case reports of patients operated on by the author within the last year are presented.

LAWRENCE A. PILLA, M.D.
University of Louisville

Intussusception in Infancy and Childhood. Henry C. Cleveland. Am. J. Surg. **81**: 431–435, April 1951.

The author presents a detailed analysis of 35 cases of intussusception from the New York Hospital Pavilion service from 1932 to 1949. Seventy-five per cent of these cases occurred in children under two years of age.

Refusal of food occurred in almost every instance. Vomiting occurred in all but 1 of the cases, abdominal pain in 24 cases; bloody stools in 23, change in bowel habit, either constipation or diarrhea in 12. In 31 cases an abdominal mass was palpable. A barium enema study was done on only a few patients.

The ileocecal type of intussusception is the most common. At surgery, large mesenteric lymph nodes were found in 40 per cent of the series. No definite relationship could be established between the intussusception and the enlarged nodes. In 77.1 per cent of the patients reduction could be obtained by gentle massage and squeezing of the distal end of the intussusception. An intestinal resection was done in 14.3 per cent.

The over-all mortality in this series was 14.3 per cent; 60 per cent for resected cases and 6.7 per cent for unresected cases. Only by avoiding the necessity of resection by early diagnosis and prompt operation can the high mortality be lowered. In all fatal cases in this series, one or more symptoms were present for at least eighteen hours. The prognosis in intussusception can best be determined by the duration of symptoms prior to surgery.

Seven drawings; 2 tables.

RICHARD V. WILSON, M.D.
University of Pennsylvania

Solitary Diverticulum of the Ascending Colon. Case Diagnosed Before Operation. Boardman M. Bosworth and Frederick L. Landau. Surgery **29**: 523–526, April 1951.

According to the authors, 58 cases of solitary diverticulum of the cecum or ascending colon have been recorded in the English and American literature. In nearly all of these the diverticulum was found in the cecum and in all but one or two there was acute or chronic inflammation. Undoubtedly many other examples have been encountered but not reported. The importance of the condition lies in its close clinical resemblance to other far more common diseases, such as acute appendicitis, carcinoma or tuberculosis of the

cecum, and regional ileitis. Thus, it usually poses a difficult problem in differential diagnosis.

The case reported is unusual in that it was possible by thorough investigation, including intravenous pyelography and barium enema studies, to establish the diagnosis before operation. In view of a local chronic inflammation and a constriction of the bowel lumen at the site of the diverticulum, the cecum and ascending colon were removed with the diverticulum *en bloc*, and an ileotransverse colostomy was established.

Three roentgenograms; 1 photograph; 1 photomicrograph.

Megacolon and Dilatation of the Small Bowel in Parkinsonism. Alexander Lewitan, Louis Nathanson, and Walter R. Slade, Jr. Gastroenterology **17:** 367–374, March 1951.

The authors present a preliminary report on the occurrence of acquired megacolon and dilatation of the small bowel in neurologic disorders. In a survey of 120 neurologic patients, they found 18 cases of megacolon and 4 cases of dilatation of the small bowel. This high incidence of megacolon in neurologic disorders is out of proportion to the incidence in the general population.

Two cases of post-encephalitic parkinsonism are reported, one with marked dilatation of the jejunum and one with megacolon. In parkinsonism, rigidity and tremors are the outstanding features. The abdominal musculature is rigid and is ineffectual in the auxiliary evacuation of the rectum. It is a common practice in this disease to use parasympathetic paralytic drugs such as hyoscine, atropine, rabellon, and belladonna. The effect of these drugs on the intra-abdominal organs does not manifest itself clinically in an obvious manner. The somatic symptoms are more troublesome, and the patient does not stress the symptom of constipation, particularly as long as he is ambulatory. When he becomes bedridden, however, constipation becomes more marked and megacolon is apparently acquired. In a series of 19 cases of parkinsonism reviewed by the authors, the shortest history of drug intake was one year and the longest twenty years of continuous medication. An attempt was made to withdraw the drug in 3 cases in which megacolon was present to determine whether the condition was reversible but the findings were inconclusive. It is the authors' impression, however, that once megacolon has been acquired, it is not readily reversible.

Administration of parasympathetic paralytic drugs over a period of years may cause permanent damage and degeneration of the intramural nervous system, which would explain the dilatation of the small bowel and the occurrence of megacolon. At present this is merely a hypothesis, since postmortem confirmation is still lacking in this series. According to Golden, gas is not usually found in the small bowel after infancy except in small quantities in the duodenum and terminal ileum. Large amounts of gas in the small bowel are observed in most neurologic cases.

Five roentgenograms. HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Appendiceal Calculi. A Report of Two Cases and a Brief Review of the Literature. C. F. Chapple. Brit. J. Surg. **38:** 503–506, April 1951.

Roentgenologically demonstrable appendiceal calculi are uncommon. When demonstrated on a film, such a stone is likely to be confused with a urinary or biliary calculus or dismissed as a calcified lymph node.

The author reports two cases of appendiceal calculus with perforation. In each instance a single stone was present. In the first case the calculus was seen on a preoperative film as a large calcified mass with concentric laminations, in the right iliac fossa. It was thought to be a gallstone which had ulcerated through the gallbladder into the small bowel. At operation it was found within the distal half of the appendix. It measured 2.5 cm. in diameter and weighed 8 gm.

The second patient was operated upon for a typical appendicitis with perforation and pelvic peritonitis. Roentgenograms were not obtained preoperatively, but a film of the operative specimen showed a calculus impacted in the proximal end of the appendix distending the lumen. It measured 2 cm. in diameter.

As to the relationship of appendiceal calculi to appendicitis, it is agreed that they may play some part and may lead to earlier perforation once inflammation has commenced, but that they are not necessarily the original cause.

[This condition is of interest solely from the standpoint of precision diagnosis, since there is nothing different about the clinical picture of appendicitis when calculi are present. If the condition is not thought of, the surgeon may be hindered rather than helped by the x-ray report, as in the author's first case, which was diagnosed as gallstone ileus.—Z.F.E.]

Five roentgenograms; 1 photograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

A New Position for Cholecystography (Kirklin). John J. Wells. California Med. **74:** 238–239, April 1951.

For cholecystography the author uses the postero-anterior projection advocated by Kirklin (Am. J. Roentgenol. **60:** 263, 1948. Abst. in Radiology **53:** 141, 1949). The patient is immobilized on a plain high table with a canvas band, in a true right lateral position, with the abdomen against the x-ray table. Advantages of this position are given as: (1) The gallbladder tends to gravitate to the patient's right side, away from the spinal column, and the gas-filled intestines tend to rise above the heavy, filled gallbladder. (2) Movement of the patient which might blur the gallbladder shadow is easily avoided. (3) The contrast medium tends to enter the bile ducts in a greater number of cases. (4) More effective demonstration of the layering of the bile is achieved, a point of academic interest to many examiners. (5) Gallstones which may not be visible on films taken in the usual position are demonstrated.

So efficient has this position proved to be in the author's experience that it is used routinely to complement the usual cholecystographic positions.

Ten roentgenograms; 1 photograph.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Two Cases of Hepatosplenography with Thorotrast, Injected Sixteen and Fourteen Years Ago, Respectively. L. Arrieta Sánchez. Radiología (Panama) **1:** 26–30, December 1950. (In Spanish)

Thorium dioxide, or thorotrast, contains 22 per cent of the metal by volume. The thorium contained in the usual dose of 75 c.c. is equivalent to 1.5 to 3.0 micrograms of radium. After intravenous injection the liver

presents a relatively homogeneous density equal to that produced by the vertebral column. In rare cases there may be a mottling which is always more delicate in the normal organ than in cirrhosis. The cirrhotic liver shows a diffuse mottling together with changes in size and configuration. Metastases are seen as rounded areas of lesser density encircled by a halo of greater density. Abscesses appear as rounded areas of diminished opacity without a halo. The density of the spleen is comparable to that of the ribs.

When patients are examined years after the injection, one observes on the abdominal films opacities produced by the upper lymph nodes of the abdomen. These are caused by emigration of Kupffer cells from the liver and spleen loaded with thorotrast. The thoracic nodes almost never show evidence of the drug. The thorotrast remains in the reticulo-endothelial system for an undetermined number of years.

In December 1934, a woman received several intravenous injections of thorotrast to show a probable liver abscess with break-through into the right bronchus. At that time the liver was reported to be of increased density, but no abscess could be demonstrated. The spleen also was dense and enlarged, reaching the level of the iliac crest. In 1950, at the age of fifty, this patient was re-admitted to the Santo Tomás Hospital, Panama, for ascites and possible intestinal obstruction. The abdominal film showed a small somewhat reticulated liver and dense spleen with numerous flecks of (metal) density between the two organs, over the upper and middle abdomen. Ascites produced a general opacity; no obstruction was found. Over the liver and spleen a Geiger counter gave 10 counts per minute, equivalent to 0.26 micrograms of radium.

In a second patient, a man of 49 years, bizarre densities were seen in the right hypochondrium and the eleventh left interspace during cholecystography in May 1950; the gallbladder was not visualized. Reexamination with flat films showed the same numerous punctate opacities, mostly in the portal region of the liver and the hilus of the spleen. Hospital records revealed a previous admission in March 1936, with an x-ray report of an enlarged liver. Because of the radiographic appearance, it was assumed that thorotrast was injected during the previous hospitalization to rule out a liver abscess. A smaller dose was postulated for this man, as the residual signs were not equal to those in the previous case.

In conclusion the author quotes the work of Olsson and Ekman (Acta. radiol. **31**:33, 1949) and expresses his hope for innocuous methods of hepatography. [See Thomas et al.: Radiology **57**:669, 1951.]

Two roentgenograms. H. F. PLAUT, M.D.
Dayton, Ohio

Meconium Peritonitis. George B. Packard and Levi E. Reynolds. Ann. Surg. **133**: 548–554, April 1951.

Meconium peritonitis is a sterile chemical or foreign-body peritonitis due to escape of meconium from the intestinal tract into the general peritoneal cavity. Fetal meconium peritonitis is generally considered to be due in most instances to obstruction caused by stenosis, atresia, volvulus, or bands, though less common conditions, such as defective blood supply, may be a factor in some. Normally, meconium reaches the ileocecal junction at the fourth month and the rectum by the fifth month, the entire small intestine being distended with it at birth. A blockage of this meconium during fetal life results in varying degrees of bowel distention. If the distention is sufficiently great, perforation may take place, to be followed by intrauterine meconium peritonitis. It is not clear why some of these perforations seal and leave as evidence only encapsulated areas of yellowish material partially calcified, having the appearance and cellular structure of old meconium.

Meconium peritonitis occurring at or immediately after birth is not necessarily the result of intestinal block, though obstruction is thought to be the underlying cause in close to 50 per cent of the cases.

The chief presenting sign of intrapartum peritonitis is distention, which may be present immediately after birth. The infant appears to be in distress, the color is poor, and respiration is grunting. Vomiting occurs early after birth, is persistent, and soon becomes bile-stained. Peristalsis is usually absent. The distention and vomiting are progressive until death one to four days later.

Besides these characteristic signs of peritonitis, the roentgen observations are of the greatest value. Dilated loops of small intestine point to obstruction and areas of calcific density suggest fetal peritonitis though not necessarily active at birth. Of chief importance is the presence of free air in the peritoneal cavity, which is best shown in the upright position.

Two cases are included, the first due to intrauterine bowel perforation, with fatal outcome, the other resulting from an intrapartum perforation, recognized sufficiently early for successful treatment.

Five roentgenograms; 2 photomicrographs; 1 photograph. BERT H. MALONE, M.D.
Jacksonville, Fla.

HERNIA

Unusual Diaphragmatic Hernia with Displaced Liver. Louis F. Knoepp. J. Thoracic Surg. **21**: 394–397, April 1951.

A 59-year-old man was troubled by right chest pain of many years duration. He had, also, mild dyspnea and frequent dry cough. He had received a stab wound of the lower right anterior chest eighteen years before.

A chest film showed a lobulated mass filling the entire lower half of the right hemithorax, continuous with the diaphragm. The heart was displaced slightly to the left. A loop of barium-filled colon appeared above the normal diaphragm level, anterior to the mass. Diagnostic pneumoperitoneum was done, and the air ascended and partly surrounded the mass. No evidence of the gallbladder was revealed after dye ingestion.

On surgical exploration three-fourths of the liver, the gallbladder, and the hepatic flexure of the colon were found in the right thorax. A large rent in the diaphragm and a 4 cm. hernia in the seventh interspace were believed to be related to the 18-year-old stab wound. Torsion and angulation of the inferior vena cava were present until the liver was returned to the abdomen. Such hepatic displacement may be the cause of serious cardiovascular impairment if not corrected early. In this case a sedentary life probably helped to obviate the development of real cardiac difficulty.

Three roentgenograms; 1 drawing.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

THE MUSCULOSKELETAL SYSTEM

Fibrous Dysplasia of Bone. Paul Strassburger, C. Zent Garber, and Halford Hallock. J. Bone & Joint Surg. **33-A:** 407–420, April 1951.

The lesions of fibrous dysplasia in bone are histologically composed of fibrous and osteoid tissue and, occasionally, islands of cartilage. Patients with this condition may be divided into three groups.

1. Those with single or multiple lesions in one bone.
2. Those with lesions in several bones, with or without skin pigmentation.
3. Those with multiple bone lesions, dermal pigmentation, and precocious puberty, either alone or associated with skeletal maturation.

Roentgenologically there are areas of decreased density in the cortical structure due to replacement of the normal bony trabeculae by fibrous and osteoid tissue. The involved areas may increase in size with time, and expansion and thinning of the cortex ensue. Laboratory findings are usually normal except that there is frequently an elevation of the basic phosphatase.

The main condition to be considered in the differential diagnosis is osteitis fibrosa cystica. Hyperparathyroidism can be distinguished by adult onset, generalized bone decalcification, high blood calcium, and low blood phosphorus levels. Sarcoid lesions are usually more marked in the hands. Osteitis deformans, multiple myeloma, osteolytic medullary neoplasms of primary or secondary nature, enchondromatoses, reticulo-endothelioses, cysts and giant-cell tumor are distinguished roentgenographically, biochemically, or by biopsy.

The authors' clinical experience with fibrous dysplasia is based on 9 cases, which are presented in tabular form. Three patients had monostotic lesions, 4 had polyostotic lesions, and 2 had the full symptom complex of polyostotic lesions, skin pigmentation, and sexual precocity.

Nine roentgenograms; 5 photomicrographs; 3 photographs; 3 tables. JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Osteitis Deformans. A Theory of Its Etiology. Sherwood Moore. J. Bone & Joint Surg. **33-A:** 421–430, April 1951.

Osteitis deformans, or Paget's disease of bone, is characterized in its earliest phase by rarefaction and loss of mineral content, with marked porosity. In the second stage, that of repair, the bone shows a coarse striated texture and mottling which are seen in no other condition. There is also an increase in bone volume, with subsequent deformities. Deformity and thickening of the skull may give rise to optic nerve or spinal cord compression. In a certain percentage of patients osteogenic sarcoma develops.

The bone in Paget's disease is quite vascular when encountered surgically or as evidenced by measurements of blood flow. In generalized Paget's disease there are often signs of congestive failure which may be due to cardiac strain against a widened vascular bed in bone.

The author proposes a disorder of the autonomic nervous system for causation of the vascular changes in bone which lead to osteitis deformans. This mechanism, it is stated, explains the increased volume flow of blood in the involved bone, the stage of bone resorption and repair, increased growth of bone, and local thermogenesis. Expected adjacent soft tissue changes, however, are not present.

Twenty-two roentgenograms; one graph.
JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Multiple Myeloma Complicating Paget's Disease. Robert J. Gross and Gabriel Yelin. Am. J. Roentgenol. **65:** 585–589, April 1951.

The coexistence of Paget's disease and multiple myeloma is rare. The authors found only two previously reported cases in the literature (Schmorl: München med. Wchnschr. **59:** 2891, 1912; Reich and Brodsky: J. Bone & Joint Surg. **30-A:** 642, 1948. Abst. in Radiology **52:** 897, 1949). They report a third one, occurring in a 67-year-old white man in whom the complicating myeloma was unrecognized until postmortem examination was performed. The Paget's disease had been diagnosed at the time of an earlier admission. Films of the skull at necropsy revealed the punched-out areas of myeloma in the calvarium as well as the typical changes of Paget's disease.

When the lesions occur together, they may be very difficult to differentiate, as the changes due to Paget's disease can mask those of myeloma for a considerable period.

Four roentgenograms; 1 photograph; 5 photomicrographs. RICHARD A. SILVER, M.D.
Indiana University

Generalized Torulosis with Bone Involvement. Morris F. Wiener. Arch. Int. Med. **87:** 713–726, May 1951.

A case of generalized torulosis with osseous invasion in a 53-year-old man is reported. The patient gave a history of recurring fever over the past ten years and severe headache of thirty days duration. On admission he appeared to be chronically and severely ill, with superficial lymphadenopathy, pallor, indistinct optic disks, and low-grade fever. Roentgenograms of the skull and of the heart and lungs were normal. The lumbar portion of the spine and pelvis exhibited definite osteoporosis. About six weeks later roentgen studies revealed small, rounded and ovoid osteolytic lesions in the lower part of the left ilium, upper part of the humerus, head of the radius, and proximal end of the right femur. A clinical diagnosis of cancer, of undetermined type and location, was made. On the forty-first hospital day, respiratory changes developed, and ten days later the patient died.

Necropsy showed systemic mycosis due to *Cryptococcus neoformans* (torulosis) mainly involving the brain and leptomeninges, bone, and lymph nodes, with probable origin from a nodular pulmonary infection. Secondary visceral amyloidosis was present.

A brief survey of the literature on torulosis is made, and the mycologic features, portal of entry, pathological aspects, diagnosis, treatment, and prognosis are discussed.

Two roentgenograms; 4 photomicrographs.

Cooley's Erythroblastic Anemia. Some Skeletal Findings in Adolescents and Young Adults. John Caffey. Am. J. Roentgenol. **65:** 547–560, April 1951.

Case reports are given for four patients with Cooley's anemia who were followed from childhood to adolescence or adult life, with convincing demonstration of the skeletal changes which occur at different ages.

The bone changes in this disease are due primarily to overactivity of the bone marrow. Their distal regression and central persistence with advancing age follow the pattern of regression of normal marrow from the distal portions of the skeleton toward the trunk. Near the onset of puberty the lesions in the tubular bones of the extremities were found to regress, and, as the patients grew older, changes in the central segments of the skeleton persisted and increased. Thus, after puberty, the skull, spine, and pelvic bones were the optimal sites for demonstration of roentgenographic changes in the bones, in contrast to the hands, which are the optimal site in childhood.

Pneumatization of the maxilla, sphenoid, frontal and temporal bones was retarded at all ages, but the retardation became more conspicuous as age advanced. Theoretically these structures fail to pneumatize in direct proportion to the degree in which they participate in blood-cell production. Thus the ethmoid sinuses developed normally in all cases studied.

Overgrowth of the maxilla in these patients not only produces severe malocclusion of the jaws but is likewise responsible for the ocular hypertelorism and rodent facies seen in some of the adult cases.

Thirty-three roentgenograms; 5 photographs.

D. E. VIVIAN, M.D.
Indiana University

The Looser-Milkman Syndrome: Occurrence in a Case of Idiopathic Steatorrhoea. Christopher Strang. Brit. J. Surg. **38:** 489–498, April 1951.

In the twenty years since Milkman published his account of multiple spontaneous symmetrical pseudofractures, it has gradually been realized that they may occur in any disease which can produce osteomalacia. Band-like zones of decalcification occur in otherwise normal-looking bone, extending transversely or diagonally across the shaft, without displacement. There may or may not be periosteal proliferation and increased density of bone at the edges of the bands. Any bone may be involved and the changes tend to be symmetrical. Pain, difficulty in walking when the femur or pelvis is involved, and tenderness over the pseudofractures are among the symptoms.

A case is reported which complicated idiopathic steatorrhea with Vitamin D deficiency from failure of fat absorption. Pseudofractures were seen in the femurs and ribs and an actual fracture in the neck of the left femur. Complete cure was obtained with large doses of Vitamin D, calcium, and iron over a period of three months; the fractures healed completely.

Fifty-seven cases of Looser-Milkman syndrome in the literature are summarized in tabular form. Several of these also were associated with non-tropical sprue or idiopathic steatorrhea.

Ten roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Problems of Pathological Fractures. Otto Lehmann. Bull. Hosp. Joint Dis. **12:** 90–102, April 1951.

Pathological fractures may complicate benign or malignant (primary or metastatic) bone conditions. In the benign conditions the occurrence of fracture usually presents no particular problem; the fracture is reduced and immobilized and the underlying lesion treated according to the indications.

Fracture through a primary malignant tumor, as osteogenic sarcoma, carries a grave prognosis [probably because during the time it has taken to weaken the bone to that extent metastasis has occurred]. Since amputation is almost always indicated, treatment of the fracture requires little attention. Because of the more favorable prognosis in radiosensitive tumors, as endothelioma, reticulum-cell sarcoma, and myeloma, fractures in these cases call for much the same treatment as uncomplicated fractures, though special procedures may sometimes be indicated.

Fractures through metastases are probably the commonest type of pathological fracture. In metastases from the breast or prostate the response of the primary tumor to hormone therapy and/or roentgen therapy justifies the use of irradiation or internal fixation (especially intramedullary nailing), since the patient may enjoy months or years of additional life. Definite healing of the fractures takes place in many cases. The author does not believe that objections to intramedullary nailing as contributing to dissemination of tumor cells are justified.

Five cases are illustrated before and after treatment.

Ten roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Juvenile Type of Werner's Syndrome. Progressive Musculocutaneous Dystrophy Observed for Eighteen Years. Donald C. Shelby and John O. Vaughn. J. Pediat. **38:** 559–570, May 1951.

A puzzling case is reported of extensive atrophy and sclerosis of the skin, fibrous tissue, muscle and bone, the dystrophy beginning when the patient was one week of age and progressing for eighteen years to a profoundly disabling disorder. Roentgenograms of the long bones taken at five months of age were normal. Roentgen studies at the age of eighteen years showed marked gross deformity of the hands and feet, with extensive bony demineralization and osteoporosis. The fascial planes of the legs and forearms were widely calcified. The knee and elbow joints were narrowed and largely obliterated by the ankylosis. The shoulder and hip joints were normal, as were the lung fields, the cardiac silhouette, and the cranial vault. No abnormality of the gastro-intestinal tract could be demonstrated.

The difficulties of diagnostic classification are discussed. The authors believe that the case is sufficiently similar to the recorded cases of Werner's syndrome, or progeria, in the adult to justify its diagnosis as a variant form of that condition.

Six roentgenograms; 5 photographs; 3 photomicrographs.

Xanthomatous Joint Tumors. W. L. Minear. J. Bone & Joint Surg. **33-A:** 451–458, April 1951.

Intra-articular xanthomata have been described in less than one hundred instances in the literature. Five cases reported by the author are believed to bring the total to 81. These tumors, known also as pigmented villonodular synovitis (Jaffe, Lichtenstein and Sutro: Arch. Path. **31:** 731, 1941), usually arise from the synovia of the knee, occasionally of the ankle.

The diagnostic features are intermittent pain and swelling and mild interference with mechanical function. Aspiration of orange-brown fluid containing large amounts of cholesterol is pathognomonic. Roentgenographic study is usually of little positive aid, although bone erosion from the larger tumors has been

seen occasionally in cases of long standing. A soft-tissue tumor is often palpable but presents no diagnostic features. A calcific intra-articular tumor is probably a synovioma.

Five roentgenograms; two photomicrographs.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Synovial Sarcoma. A Clinical Impression Obtained from the Study of Thirteen Cases. Kirk J. Anderson. West. J. Surg. **59**: 141–149, April 1951.

The author discusses the diagnosis and treatment of synovial sarcoma on the basis of 13 cases. He believes the rarity of the condition is probably more apparent than real.

As a general rule, these tumors are most prevalent in young adult males. They are slow to develop, and swelling and pain are the most consistent manifestations. The lower extremity was most frequently involved in the present series, 5 of the 13 tumors occurring in the knee joint. The remainder were distributed in the thigh, ankle, foot, shoulder, and wrist joint in that order. Para-articular bursae and tendon sheaths appear to be the most frequent sites of involvement. In contradistinction to the usual belief, the joint synovial membrane is less frequently involved. Of the 13 cases, 7 were of bursal origin, 3 of tendon sheath origin, 2 intra-articular, and 1 of adventitial bursal origin.

Roentgenographic features consist of a homogeneous synovial thickening, but the joint space is not disturbed as a rule. Less commonly there is concomitant destruction of bone and cartilage within the joint. Calcification within the para-articular tumor is quite diagnostic. Absence of demineralization about the joint is against a diagnosis of tuberculosis and infectious or rheumatoid arthritis. Lack of degenerative changes in the joint usually rules out hemophilia.

Treatment consisted of amputation preceded by biopsy or excision in 7 of the 13 cases. A high rate of recurrence after local excision indicates the malignant nature of this tumor. Roentgen therapy was utilized in 3 patients, one of whom exhibited a clinical response with pain reduction and regression of mediastinal adenopathy.

Treatment should be radical. Accessible tumors should have the benefit of wide excision. Prompt amputation should be performed on the advent of recurrence and on all inaccessible tumors. Radiation treatment alone is of temporary palliative value.

Ten roentgenograms; 2 photographs; 1 table.

ROBERT H. LEAMING, M.D.
Memorial Center, N. Y.

Cleidocranial Dysostosis Syndrome. Report of a Case in a Negro Child Exhibiting Retarded Growth. Roland B. Scott and L. Otto Banks. Am. J. Dis. Child. **81**: 394–402, March 1951.

According to the classic description, the congenital syndrome known as cleidocranial dysostosis consists in aplasia of one or both clavicles, exaggerated development of the transverse diameter of the cranium, delay in the ossification of the fontanels, and hereditary transmission. Clinically the most prominent sign is the defect of the clavicles and extreme mobility of the shoulder girdle. The disease affects all races, but the authors have been able to find only three recorded cases occurring in American Negroes. The case reported in their article represents the fourth in that race and is unique in that the child, four years old at the time of the report, had been followed from birth.

The patient—a girl—presented the characteristics of the syndrome as originally described by Marie and Sainton, with the exception of the hereditary trait. When she was last examined at the age of four years and four months, the anterior fontanel was still patent. Weight, stature, dentition, and epiphyseal maturation were retarded throughout the period of observation. Periodic roentgenograms demonstrated the total absence of clavicles and faulty ossification of the cranium, with patent fontanels and many wormian bones. Delayed bone age and absence of pubic bones were additional significant findings. The multiple developmental abnormalities are attributed by the authors to a widespread defect in the germ plasm, which they believe is characteristic of the cleidocranial dysostosis syndrome.

The authors feel that the term "cleidocranial dysostosis" is an unfortunate one, since it has caused the defects of the clavicle and the skull to be emphasized to the neglect of the other portions of the body. Anspach and Huepel (Am. J. Dis. Child. **58**: 786, 1939) have indicated that this is a widespread skeletal disease, and Cooper (M. Ann. District of Columbia **10**: 334, 1941) has enumerated one hundred abnormalities which have been associated with the syndrome.

Seven roentgenograms; 1 photograph; 3 graphs.

HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Some Observations on 100 Cases of Ankylosing Spondylitis. L. J. A. Parr, Paul White, and Eva Shipton. M. J. Australia **1**: 544–549, April 14, 1951.

Ankylosing spondylitis is considered an entity and not as rheumatoid arthritis of the spine. The authors analyze 100 cases seen in hospital and private practice. The ratio of males to females was approximately 5:4; the average age of onset, twenty-six years. An average period of 5.8 years elasped between the onset of symptoms and a correct initial diagnosis, and a correct diagnosis was made initially in less than half of the recorded cases. Associated factors such as climate, neisserian infection, pelvic infection, tuberculosis, and athletic build seemed to be without etiologic significance.

Analysis of plasma proteins in 20 cases in general gave no more idea of the severity of the disease than the erythrocyte sedimentation rate. Of the 2 cases, briefly discussed, in which determinations were made before and after x-ray treatment, one showed lowering of the euglobulin fraction as an indication of improvement; the other showed a rise in this fraction but a lowering of albumin and globulin contents, as well as of the erthyrocyte sedimentation rate.

The long delay in arriving at the correct diagnosis and the high incidence of initially incorrect diagnoses indicate the importance of being aware of this disease. One should not wait for radiographic evidence before instituting therapy. Diagnosis may be made in the prodromal or pre-radiologic stage, but is often difficult because of the generalized distribution of pain. Symptoms usually begin in the low back but are sometimes mild and fleeting, and therefore go unnoticed. They may then concentrate in other parts of the body, as the cervical or dorsal spine, shoulders, or knees. If radiographic investigation does not include examination of the sacro-iliac joints, no abnormality may be shown.

and an incorrect diagnosis, usually of fibrositis, may obscure the true nature of the ailment for years. It is also true that clinical evidence of disease may be present in all or any part of the spine, including the sacro-iliac joints, without radiographic changes. Forty-two per cent of the cases in this series manifested initial symptoms in areas other than the low back, *e.g.*, hips, posterior thighs, cervical and dorsal spine, and peripheral joints (excluding small joints of the hands and feet). Any pains in these areas should lead to a search for antecedent low back symptoms.

X-ray findings in the sacro-iliac joints are classified as follows: Type I: bony ankylosis present (20 per cent); Type II: gross changes, no ankylosis (56 per cent); Type III: osteoporosis or other minimal changes (14 per cent); Type IV: no osseous lesion at original examination (10 per cent). Of the last group of 10 cases, 8 showed subsequent changes within a period of three to eight years.

X-ray therapy was the chief therapeutic tool and led to relief or improvement in 96 per cent of the cases. Given a typical history in a susceptible age group, there is valid indication for a trial of x-ray therapy even if objective clinical signs are lacking. The technic used was as follows: 60 to 100 r twice weekly for ten treatments; 12 × 6-inch or 12 × 12-inch mid-line ports; 130 to 140 kv.; 5 ma.; filtration of 1 mm. Al plus 0.25 mm. Cu. The course may be repeated within two to three months.

Results are best when treatment is given early. For this reason the importance of diagnosis in the prodromal stage is stressed.

Five tables.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

Surgical Treatment of Herniated Lumbar Intervertebral Discs. Follow-up Study of 130 Patients Without Spinal Fusion. Karl S. Alfred. Am. J. Surg. **81**: 390–400, April 1951.

The end-results of surgical treatment of herniated or ruptured intervertebral disks are evaluated through the study of 130 cases one year or more after operation. The average postoperative period was three years and three months.

Intervertebral disk lesions are recognized as degenerative in nature. A history of trauma was obtained in 48.5 per cent of the cases, and in the majority it was severe. The patients usually felt a "snap" in the lower back at the time of trauma, with immediate back pain later radiating down the back of the leg. Leg pain was a presenting symptom in every case, while back pain was absent in one case and mild in ten. Paresthesias were commonly present but were not a prominent complaint. Lumbar spasm, limitation of back bending, and limitation of straight leg raising were routinely observed. Neurologic examination was the most helpful procedure in localizing the lesions, reflex changes being most significant. In the absence of reflex changes, the lesion was usually found in the fourth lumbar interspace; loss of the ankle jerk was present in 65 per cent of fifth space lesions.

Myelograms were obtained routinely only in cases to be treated surgically. The author feels that myelography has its greatest application in ruling out tumors and double lesions. On the question of residual pantopaque in the spinal canal, it is believed that it may be a factor in the formation of adhesions.

Spinal fluid was normal in every case except one. In this isolated case the fluid was xanthochromic, with a total protein of 1,200 mg. At operation a complete block of the cauda equina was found with severe compression of all nerve elements associated with complete paralysis.

Laminectomy was the operative procedure, but in the majority of cases no bone or only a very small portion of bone was removed. Such a procedure has been termed a laminotomy. The knee chest position was employed in 32 cases. It has the advantage of widening the interspinous spaces and permits of lessened bone removal. As much of degenerated nucleus pulposus was removed as was possible. Opening of the dura should be avoided as this may lead to adhesions or formation of spinal fluid cysts. Postoperative complications were few. Twelve patients or 9.2 per cent required re-operation, 2 because of the formation of spinal fluid cysts, 6 for recurrence at the same space, 1 for ruptured disk at a higher level, 1 for varices, and 2 for adhesions.

Ninety-one per cent of the patients returned to the same kind of work, 8.4 per cent returned to a different kind of work, and 0.8 per cent or the one patient with complete paralysis was unable to work at all. Eighty-seven per cent of the patients themselves reported 100 per cent improvement, 8.4 per cent reported 75 per cent improvement, and 4.6 per cent reported 50 per cent improvement. The most common postoperative changes as a result of the surgical procedure were permanent reflex changes in 45 per cent and areas of numbness and hyperesthesia in 44.6 per cent.

X-ray examination of the lumbar spine was done preoperatively in all cases. The significant findings were a straight spine in many cases, list of the lumbar spine, and narrowing of the intervertebral space. The latter finding was reliable only if found in the fourth space. In the majority of cases, the x-ray examination was negative. Postoperative films revealed some narrowing of the disk space in 73.8 per cent of the series, while 26.2 per cent showed no changes. Arthritic changes, consisting of sclerosis of vertebral end plates at the site of the lesion, occurred in 30 per cent of the cases operated upon, but all these cases were asymptomatic. Arthritis as result of strain on the posterior articular facets was found in only one case, in which two disk operations were done at the same site. The author thought that this single patient was the only one of the series who might have benefited from a spinal fusion.

Eight roentgenograms; 8 tables.

CHARLES EBY, M.D.
University of Pennsylvania

Lumbar Spinal Arachnoiditis: A Complication of the Intervertebral Disc Operation. Edmund A. Smolik and Francis P. Nash. Ann. Surg. **133**: 490–495, April 1951.

The authors report four cases in which intervertebral disk operations were followed by either partial or complete spinal block. Subsequent studies showed an advanced degree of spinal arachnoiditis in all. The explanation for this lies in the fact that while the dura is relatively inert and merely represents the fibrous containment of the brain and spinal cord, the pia arachnoid carries the blood vessels and contains mesenchymal cells which on injury lend themselves to extensive proliferation. When the outer arachnoidal layer is destroyed, reaction ensues between the mesothelial lining of the dura and the mesenchymal cells of the pia arachnoid. This is the obliterative arachnoiditis.

All of the patients following surgery had augmented

complaints of low back pain, with either unilateral or bilateral radiation to the leg. In all instances there were sensory deficits and in two cases motor weakness of a progressive nature was present. In two instances there was almost total incapacity.

Myelography is the most useful method of demonstrating the leptomeningeal involvement. The findings are either string globulation or total block.

Seven roentgenograms. BERT H. MALONE, M.D.
Jacksonville, Fla.

Vertebral Manifestations of Malignant Lymphoma, Myeloid Leucemia, and Multiple Myeloma. Robert Mazet, Jr. Surgery **29**: 545–554, April 1951.

Prior to the advent of roentgenography, the osseous manifestations of malignant diseases of the reticuloendothelial tissue were infrequently recognized. During the past two decades skeletal involvement in these conditions has become more generally known, although its frequency and extent are still not fully appreciated. One reason for this is that the bony changes are not visible roentgenologically unless there is extensive affection of spongiosa or destruction of the cortex. The marrow may be almost entirely replaced by tumor tissue without change in the density of the shadow cast in the films. Necropsy studies show that bony involvement invariably is substantially greater than the evidence on the roentgenograms would lead one to believe. Especially in myeloid leukemia, and frequently in multiple myeloma, there is tissue replacement within the bone when no lesion is demonstrable roentgenographically.

Except for the acute leukemias of childhood, diseases of the reticulo-endothelial system occur for the most part in the middle decades of life. They are found, roughly, twice as often in males as females. Symptoms, signs, and laboratory findings are in a large measure dependent upon the organs affected. Bone involvement is an early rather than a late manifestation of these conditions. There are no pathognomonic roentgen changes.

The data on 62 autopsied cases are presented in tabular form. This group included 28 cases of Hodgkin's disease, 8 of lymphosarcoma, 6 of reticulum-cell sarcoma, 5 of lymphatic leukemia, 8 of multiple myeloma, and 7 of myeloid leukemia. X-ray examination disclosed osseous lesions in 14.5 per cent of the cases. Vertebral lesions were present in 1 case of Hodgkin's disease, 1 case of reticulum-cell sarcoma, 3 cases of multiple myeloma, and 1 case of myeloid leukemia. Changes in bones other than the vertebral column were demonstrated in 4 cases of Hodgkin's disease, in 4 cases of multiple myeloma, and 1 case of myeloid leukemia. The number of cases showing bony involvment at autopsy was much higher. In the Hodgkin's group lesions were found in the vertebrae in 20 cases and in other bones in 12 cases.

A biopsy of vertebral lesions of questionable nature has proved of value in the author's experience.

Five roentgenograms; 3 photomicrographs; 1 photograph; 3 tables.

Vascular Epiphyseal Changes in Congenital Dislocation of the Hip. Results in Adults Compared with Results in Coxa Plana and in Congenital Dislocation Without Vascular Changes. William K. Massie. J. Bone & Joint Surg. **33-A**: 284–304, April 1951.

Much evidence points towards a common pathogenic background for the epiphyseal changes seen following reduction of congenital hip dislocation and those of coxa plana. The author has made a comparative study of the two conditions. Of 72 congenitally dislocated hips, 75 per cent showed changes sufficiently suggestive of vascular disturbances to justify analysis. Thirty per cent, called by the author the "involved" group, in the early months after reduction showed changes in the epiphysis similar to coxa plana. Convexity of the metaphyseal edge of the epiphyseal line and fragmentation of a portion of the epiphysis were common to all grades of severity. In the least severe cases, fragmentation disappeared after a years time and the adult femoral head was of almost normal conformity. In cases of Grade II severity, the adult head exhibited a variety of deformities and in the most severe cases complete destruction of the femoral head was noted. Forty per cent of the series constituted a "mixed" group, showing early abnormal epiphyseal changes but lacking the fragmentation characteristic of both the involved group and typical coxa plana.

A comparison of the salient roentgen features (expressed in grades of severity from 0 to 4) in congenitally dislocated hips and coxa plana is given in the following table:

Roentgenographic Findings	Grade of Severity in Congenitally Dislocated Hips, Involved	Grade of Severity in Coxa Plana
Density of epiphysis	1	4
Metaphyseal osteoporosis, either alone, or in combination with cyst formation	1	4
Fragmentation of the epiphysis	3	4
Medial metaphyseal lip deficiency	4	1
Premature convexity of metaphyseal edge	4	1
Broadening of metaphysis	4	4
Arthritis in the adult	4	2

The author believes that the similarity in appearance and behavior of the involved congenital hips and those of coxa plana strongly suggests a common pathological basis, and since it is well substantiated that the coxa plana changes are fundamentally vascular, it is presumed that the changes in congenital hip dislocation are also of a vascular nature. The etiology of these vascular changes is unknown. A congenital predilection to vascular injury is postulated on the basis of individual variations in the vascular supply to the femoral head.

The role of trauma in epiphyseal degeneration following reduction of congenitally dislocated hips is difficult to assess. Certainly changes due to trauma may be lessened by more careful manipulation in reduction. Unfortunately increased susceptibility to vascular injury is not amenable to control with our present knowledge.

The later the initial reduction of a dislocated hip, the more likely is epiphyseal degeneration. Early recognition of the epiphyseal changes following reduction is of utmost importance for a successful therapeutic effect.

Prohibition of weight bearing is necessary until the femoral head appears healed roentgenographically.

Eighty-one roentgenograms; 9 tables.

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The Henry Ford Hospital

Fractures of the Neck of the Femur in Children. A Clinical Study. Guillermo Allende and Luis G. Lezama. J. Bone & Joint Surg. **33-A:** 387–395, April 1951.

Compared with the frequency of femoral neck fractures in adults, these fractures in children are rare. The authors have studied eight children with femoral neck fractures, who were between three and fourteen years of age.

The main factors of importance for surgical consideration are the obliquity of the fracture line and the possible appearance of aseptic necrosis. The probability of satisfactory circulation to the fractured neck is more favorable after the anastomosis of the retinacular arteries and the foveolar arteries. This occurs between eleven and thirteen, when the ossification center for the femoral head reaches full development.

Twenty-three roentgenograms; two figures; one table.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Congenital Curvature of the Tibia. Max S. Rabinowitz. Bull. Hosp. Joint Dis. **12:** 63–74, April 1951.

Congenital curvature of an otherwise normal appearing tibia (and fibula) is a rare condition, there being less than 25 examples reported in the literature. The author has seen five cases characterized by posterolateral curvature of the leg with calcaneovalgus and a tendency toward spontaneous correction.

The etiology is not known. The condition may be due to a congenital defect in ossification or it may be that some kind of intra-uterine pressure is at fault. Manipulation and gradual wedging of casts applied to the legs gave good results but there was definite retardation of growth of the affected tibia, resulting in significant inequality of length.

The condition is probably the same as or closely related to that described by Caffey (Am. J. Dis. Child. **74:** 543, 1947. Abst. in Radiology **51:** 441, 1948) as "prenatal bowing and thickening of tubular bones," although his cases involved the humeri and femora as well as the tibiae. It is not related to congenital pseudarthrosis, since no defect in the bony structure has ever been observed.

Three cases are illustrated, 2 with late follow-up films (seven and twelve years).

Ten roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Fatigue Fractures of the Tibia. Robert P. Kelly and Fred E. Murphy. South. M. J. **44:** 290–296, April 1951.

The concept of fatigue fracture of bone is that a basically sound material undergoes mechanical dissolution in response to prolonged concentration of localized strain. A kindred group of lesions is known in which zones of deossification appear on a background of generalized skeletal disease (Looser's zones). Characteristic and fairly constant localization of the lesions is common to both categories.

The authors summarize the observations in 41 previously reported cases of fatigue fracture of the tibia and add 2 cases. They believe that there is sufficient similarity in the clinical and radiographic features of this aggregate of cases to justify regarding them as an entity.

Fatigue fracture of the tibia appears to be a condition affecting the young, occurring more commonly in males, often among those in military service. The commonest site is the upper third of the bone. With the possible exception of one of the authors' cases, no underlying systemic disease has been noted. In no instance is an isolated injury recorded which could be regarded as capable of causing the fracture.

Clinical features are inconstantly recorded in the previously reported cases. Tenderness and swelling are reported as present more often than absent. Increase of local heat has been noted. Pain on activity is quite frequent, with relief at rest noted in some instances. Elevation of temperature to a maximum of 100° is reported in 3 cases. Biopsy in 8 cases showed chronic inflammation in all. In 8 cases in which the lesion was explored no pus was found.

Characteristic radiographic findings are noted by most writers. Callus is seen frequently medially and posteriorly, and occasionally laterally. The presence, early in the course of symptoms, of an infraction of the medial cortex is often noted. Later a line of infraction through the cortex medially or posteriorly is frequently seen. A transverse radiopaque zone across the medullary space with occasional penetration by a hair-like radiolucent line has been described.

Ten roentgenograms.

MASON WHITMORE, M.D.
Jefferson Medical College

Fractures of the Calcaneus. A. E. Bremner and C. K. Warrick. J. Faculty Radiologists **2:** 235–241, January 1951.

This discussion of the etiology and the radiologic diagnosis of severe compression fractures of the calcaneus is based on a study of 200 cases, of which over 25 were subjected to an open operation, affording an opportunity for the direct examination of crushed bone. Of 100 cases of recent fracture of the calcaneus treated at the Royal Victoria Infirmary, Newcastle upon Tyne, during 1947 and 1948, 71 were compression fractures with displacement of the fragments.

The internal structure of the bone is briefly considered and the mechanism of compression fracture of the calcaneus is described.

When fracture of the calcaneus is suspected, it is customary to take roentgenograms of the bone in the lateral and axial projections. Great care is required with the axial view. All too often the tuberosity is projected clearly and the subtaloid joint is barely distinguishable because of the density of the superimposed structures. The authors prefer a film taken with a Potter-Bucky diaphragm, the ray being directed at an angle of 45° and centered between the heels. Anthonsen's projection (Acta radiol. **24:** 306, 1943. Abst. in Radiology **45:** 638, 1945) has been found of particular value. With his technic the x-ray beam strikes the articular surfaces of the sustentaculum tali and the posterior facet tangentially, and so demonstrates fractures, displacement, and arthritis when present.

Two groups of fracture are discussed, namely, (1) fractures with displacement of the posterior articular facet in part or in whole and (2) those with diminution of the salient angle but no joint involvement.

Nine roentgenograms; 2 photographs; 4 drawings.

Fractures of the Anterior Process of the Calcaneus. Moses Gellman. J. Bone & Joint Surg. **33-A:** 382–386, April 1951.

The bifurcate ligament attaches the anterior process of the calcaneus to the tarsal navicular and cuboid. Sudden adduction of the forepart of the foot at the lateral mediotarsal joint, especially in equinus, exerts strong tension upon the calcaneus and often results in avulsion of the anterior process.

The fracture is somewhat unusual, but of interest, and presents a problem of diagnosis rather than treatment. The fracture is not always visualized in the lateral roentgenogram but oblique views at several angles will separate the shadow of this process from the talus and demonstrate the fracture line. Treatment is analogous to that of a severe sprain.

Four roentgenograms; 2 photographs; 2 drawings.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

GYNECOLOGY AND OBSTETRICS

Clinical and Roentgen Pelvimetry: A Correlation. John E. Savage. Am. J. Obst. & Gynec. **61:** 809–820, April 1951.

Savage reports 200 cases seen in the dystocia clinic of the Department of Obstetrics at the Hospital of the University of Maryland School of Medicine and studied completely from a clinical and radiologic standpoint. The Walton-McLane isometric method of roentgen pelvimetry was employed. Cases are referred to the clinic only when there is clinical reason to suspect dystocia. The three most common causes of referral were: (1) clinically contracted pelvis, (2) previous cesarean section, (3) history of previous dystocia.

Among the 162 patients referred because of the clinical suspicion of contracted pelves, application of Mengert's indices showed contraction in 79. Of the entire series of 200 patients, 37 were found to have midplane contraction, and 23 of these had dystocia. It was felt that in cases in which the clinical measurement of the transverse ischial diameter of the outlet was 8.5 cm. or less, midplane contraction could be expected in one of every 3.5 cases and outlet contraction in one of every 3 cases.

The clinical measurement of the diagonal conjugate diameter was found to be satisfactory only in those cases in which it was more than 11.5 cm. For those in which it was less, roentgen pelvimetry was recommended. The highest incidence of operative delivery was in android and platypelloid pelvic types. With vertex presentations, a trial of labor is recommended in all but grossly contracted pelves.

The cesarean section rate in this series was 16 per cent. The incidence of prematurity was no greater than the general clinic incidence.

The author advocates a combined clinical and roentgen study of the obstetric pelvis.

T. FREDERICK WEILAND, M.D.
Jefferson Medical College

THE GENITO-URINARY SYSTEM

A Preliminary Report on Abdominal Aortography in Urology. I. H. Griffiths. Brit. J. Urol. **22:** 281–301, December 1950.

This report is a short and critical study of abdominal aortography, with the object of drawing attention to its possibilities as an adjunct to other diagnostic procedures. It is based on a series of 25 cases.

Aortography is not advocated as a routine method of investigation, but in the following conditions it may be employed as an aid to diagnosis and treatment: (1) where intravenous or retrograde pyelograms are indefinite; (2) congenital abnormalities of the kidneys; (3) retroperitoneal tumors of uncertain origin; (4) hematuria of the upper urinary tract in the absence of pyelographic changes; (5) unilateral hydronephrosis; (6) peripheral vascular disease; (7) hypertension; (8) aneurysm of the aorta or of the renal or splenic vessels.

The author's technic of aortography, using 70 per cent diodone as the contrast medium, is described. Few complications were encountered. In 2 cases the diodone was injected inadvertently into the peri-aortic tissues without any ill effect. Roentgenograms of these cases an hour later showed that the diodone had been completely absorbed. No case of iodism occurred in the present series.

Eighteen roentgenograms; 2 photographs.

Subcutaneous Urography: Description of a New Method Utilizing 70% Urokon and Hyaluronidase (A Preliminary Report). John E. Byrne and William F. Melick. Urol. & Cutan. Rev. **55:** 193–199, April 1951.

Since intravenous pyelography is very difficult in infants, the authors attempted to devise a means of giving the medium—70 per cent Urokon—subcutaneously with the addition of hyaluronidase to increase absorption.

Experimental work was first done on guinea-pigs, which were given subcutaneous injections of Urokon and other iodides along with hyaluronidase. Varying reactions were observed histologically, severe in the case of 70 per cent diodrast and 70 per cent sodium iodide, but slight with 70 per cent Urokon (200 mg./kg.) though overdosage (2,100 mg./kg. daily for seven days) produced a tubular nephrosis.

In view of the experimental results, the procedure was tried in 25 infants less than one year of age; 0.5 gm./kg. of 70 per cent Urokon was used, half the quantity being injected into each thigh immediately after injection of half an ampule of commercial hyaluronidase. The first film was taken about twenty minutes later.

Laxatives and dehydration are not used in infants, and compression proved of doubtful value. Sedation is provided beforehand in the form of elixir of phenobarbital. As soon as the injections are made, the infant is given 3 to 4 ounces of milk as rapidly as possible to fill the stomach and displace the intestinal shadows away from the kidneys. In 17 of the 25 cases, adequate pyelograms were obtained.

Four roentgenograms; 1 table; 9 photomicrographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Intravenous Urography in Renal Tuberculosis. Nils Olof Ericsson and Åke Lindbom. Brit. J. Urol. **22:** 201–207, September 1950.

While many writers have recently expressed a preference for the retrograde method of urography, the authors believe that intravenous pyelography is preferable for determining the extent of lesions in tuberculosis of the kidney. One of the disadvantages of retrograde pyelography is that it may aggravate a tuberculous cystitis.

The ureteral catheterization may also cause a lesion of the ureteral mucosa, which may become inoculated with tubercle bacilli. A pyelovenous reflux cannot always be prevented and, if this occurs, the infection may be disseminated throughout the blood stream.

The main points of the authors' technic are as follows: A laxative is administered the day before the examination, followed at night by an enema, but no enema the next morning. Twenty milliliters of a 50 per cent solution of umbradil (diodrast) are used. If the concentration of medium in the urine is not sufficient, another 20 ml. are injected.

The primary diaphragm in every instance is as small as possible, so that only the kidneys, or sometimes a single kidney, appear on the film. The Potter-Bucky diaphragm is always used. The exposure time is usually 0.7 second, never more than one second.

Compression is applied over the ureters by means of a football bladder pressed on the abdomen with a square of celluloid which is fixed to the patient by means of a belt. The compression is maintained until satisfactory films have been obtained—usually fifteen to twenty-five minutes. After fifteen minutes of compression, films in the anteroposterior and both oblique projections are made. This is easily accomplished, as the compression device is fixed to the patient and rotation is possible. Immediately after releasing the compression, pictures of the ureters in the supine and prone positions are made.

One hundred and fifty-four cases of renal tuberculosis with 173 tuberculous kidneys have been examined with this technic, and changes were seen on the films in all but one. In 80 cases the changes were typical of tuberculosis, and in 61 additional cases the possibility of tuberculosis was suggested. Since the middle of 1945 no patient with renal tuberculosis has been examined by retrograde pyelography. Forty-one cases were studied by retrograde pyelography prior to that time, and in only 5 was information added which was not obtained by intravenous pyelography.

The ureters were visualized in 80 per cent of the authors' cases; more than half showed pathological changes. The commonest observation was ureteral dilatation, which is the earliest sign of ureteritis. In some cases dilatation may be due to loss of tonicity caused by a non-specific inflammation accompanying the tuberculous process in the kidney.

Ten roentgenograms; 1 drawing.

Distortion and Displacement of the Renal Pelvis and Calices by Extrarenal Lesions. J. O. Y. Cole. J. Faculty Radiologists **2**: 242–245, January 1951.

Five cases are presented to draw attention to the fact that extrarenal space-occupying lesions can produce not only displacement but also distortion of the renal pelvis and calices. In each of these cases there was distortion of the renal pelvis and calices due to direct pressure from an extrarenal lesion. In 4 cases the lesion involved the left side, suggesting that the left kidney, because of its anatomical situation, is more prone to pressure distortion. In 3 of the 4 cases there was also displacement of the kidney. Shambaugh (Radiology **26**: 335, 1936) observed that when the left kidney is displaced by a mass in the abdomen the tumor is usually extraperitoneal. In 2 of the author's cases a retroperitoneal tumor was found. One patient had an hydatid cyst, one a perinephric abscess, and one an enlarged spleen.

Five roentgenograms.

Ectopic Ureter in Childhood with an Account of Four Personal Cases. A. J. Alldred and T. T. Higgins. Brit. J. Surg. **38**: 460–466, April 1951.

Any kidney may have an ectopic ureter, but the most common malformation of this type is a double ureter with the ectopic orifice draining the upper pole of the kidney. In the male, an ectopic orifice may occur anywhere between the site of the normal ureteric opening and the verumontanum. In the female the common sites are in the urethra, the vestibule, and the vagina.

Urinary infections and incontinence are the common clinical findings. In males incontinence is not a feature, but in females it is the commonest symptom, present from birth. When of the postural type—that is, when the child is dry lying down but incontinent when ambulant—it is practically pathognomonic of an ectopic ureter.

Careful inspection will usually reveal the ectopic orifice. If the opening is large enough, retrograde pyelography should be done. Otherwise intravenous pyelography is indicated. This will serve to outline a double kidney and ureter or at least to suggest the anomaly from distortion of the upper pole.

Four cases are reported, one bilateral, all with the usual combination of double kidneys and ectopic orifices near the external meatus. All the patients were girls and all were completely relieved by surgery.

Six roentgenograms; 5 photographs; 3 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE BLOOD VESSELS

Angiography. Charles T. Dotter, Israel Steinberg, and Robert P. Ball. Circulation **3**: 606–615, April 1951.

In this paper, appearing under the general heading "Clinical Progress," angiography of the abdomen and extremities is discussed. Subsequent papers will deal with the head and chest. The contribution is essentially a review, covering the technic, choice of opaque media, equipment, indications, potentialities, and dangers of the procedure.

Both veins and arteries of the extremities are sometimes injected against the current as well as with it, by needle puncture or after insertion of a catheter, depending upon what one is attempting to demonstrate. In general, venography of the lower extremity is concerned with problems of varicose veins, obstruction, thrombophlebitis, and generalized vascular diseases which affect the veins of the leg. Venography of the upper extremity is usually performed in an effort to identify a cause for clinically apparent venous obstruction. Arteriography of the extremities is useful in the study of arteriovenous fistulas and aneurysms, obliterative arterial disease, arterial emboli, arterial injuries and their surgical repair, and malignant bone tumors.

Of the various abdominal angiographic procedures, probably the best known is aortography. This has proved useful in the delineation of abdominal aortic aneurysm, in the differential diagnosis of renal tumors, and the demonstration of anomalies in the course of the renal vessels.

To demonstrate the abdominal veins, a number of choices are given, again depending upon what veins are to be visualized. The inferior vena cava can be demonstrated by injecting the femoral, saphenous, or even the malleolar vein. The cardiac catheter may regularly be

positioned in certain of the tributaries of the vena cava, notably the renal and hepatic veins. Forcible injection of the contrast medium is then followed by filming. Catheterization of a portocaval anastomosis has also been advocated, to test its patency. An illustration is given of a portal venogram obtained by injecting diodrast into a tributary of the superior mesenteric vein at laparotomy. It is hoped that much useful information may be obtained by portal venography in a variety of hepatic diseases.

This article is recommended as a reference outline on angiography of the abdomen and extremities.

Thirteen roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Venography of the Leg, With Particular Reference to Acute Deep Thrombophlebitis and to Gravitational Ulceration. J. D. Dow. J. Faculty Radiologists **2**: 180–205, January 1951.

The original purpose of the author's investigation was to try to determine whether venography could assist clinicians in estimating the state of the deep veins of the leg and thus influence subsequent treatment in cases of varicose and postphlebitic ulceration.

To do this, it was necessary first to establish a technic which could be relied upon to demonstrate patency of normal deep veins from the ankle to the groin. Accordingly, 134 venographic examinations were performed on patients with normal legs referred for intravenous pyelography. In Part I of the present paper the author gives the results of this phase of the investigation, and in Part II the findings concerning the deep circulation in cases of varicose and postphlebitic ulceration, including an appraisal of the method of retrograde injection of the deep veins of the leg.

Part I: The methods investigated included all those described in the literature as being suitable for use in patients suspected of having acute deep thrombophlebitis. The author found that none of the methods would fill all the main deep veins of the leg. Therefore, what is technically a normal venogram with complete filling of the peroneal, popliteal, and femoral veins cannot be held to exclude acute deep thrombophlebitis.

Excluding sedimentation, three different ways are described in which partial or irregular filling can occur in the peroneal, popliteal, and femoral veins of normal legs—variations in the rate of blood-flow within veins; intercommunicating veins between the deep veins of the leg; entry of tributaries into the main deep veins. The appearances so produced are identical with those hitherto regarded as pathognomonic of acute deep thrombophlebitis and are those on which the early venographic diagnosis of the condition has been based. Consequently, the author believes that incomplete filling of the deep veins should not be regarded as indicating the presence of acute deep thrombophlebitis.

Complete absence of filling of the peroneal, popliteal, or femoral veins may be considered abnormal. However, in venography, where the results are so dependent on technic, such a negative form of diagnosis can never be particularly satisfactory, as it is seldom possible to be certain that the absence of filling of the vein concerned is actually due to thrombosis and not to a technical error. Besides, when long stretches of vein have been obliterated by deep thrombophlebitis, the disease will nearly always have become obvious clinically, thus rendering venographic diagnosis superfluous.

The author concludes that the early diagnosis or exclusion of acute deep thrombophlebitis of the lower limb by venography must always be suspect, and venography should be used seldom, if at all, for this purpose.

Using a tourniquet at the ankle or tourniquets at ankle and knee, patency of the deep circulation can be demonstrated from the ankle to the groin in every instance in normal legs. While this is of no interest in acute deep thrombophlebitis, it may be of considerable value in cases of gravitational ulceration, especially when there is a history of deep thrombophlebitis in the limb concerned. This aspect is considered in Part II.

Part II: Gravitational ulcers are usually divided into two main groups (1) varicose ulcers, with normal deep circulation, and (2) postphlebitic ulcers, in which the deep circulation has been involved in a previous attack of deep thrombophlebitis. In varicose ulceration the initial treatment of choice is generally agreed to be as complete obliteration of the superficial veins as possible, in an effort to relieve the edema. With regard to postphlebitic ulceration, however, some difference of opinion exists. The majority of writers on the subject believe that no adequate recanalization of the deep veins occurs and that the superficial veins represent the sole means of venous return from the leg, and conservative treatment is recommended. It is not always possible to decide clinically whether the deep circulation is normal, thrombosed, or incompetent.

Sixty-two patients complaining of ulceration of the leg, 32 with a history of an attack of deep thrombophlebitis, were examined by the following technic: With the patient supine on the x-ray table, the leg was elevated to empty the superficial varices and a crepe bandage was applied firmly from the ankle to the groin. Tourniquets were then placed around the ankle and above the knee, and the opaque medium injected into any non-sclerosed, easily compressible vein, preferably on the lateral side of the foot, which had been raised slightly above the level of the table by a wooden block. After 15 to 12 c.c. of the medium had been injected, films of the lower leg were exposed, the tourniquet above the knee loosened, and films of the knee and thigh regions exposed as the injection was completed.

Of the 36 cases with varicose ulcerations, 31 were considered clinically to have a normal deep circulation. In the other 5 cases thrombosis of the deep circulation could not be excluded. Venographic examination showed the deep circulation to be patent and normal from the ankle to the groin in all 36 cases. The peroneal, popliteal, and femoral veins filled in every instance, and in 27 the posterior tibial vein was also visualized.

Of the 26 cases of postphlebitic ulceration, 7 cases were considered to have a normal deep circulation clinically. By venography, in all 26 cases, the deep circulation was again found to be completely patent from the ankle to the groin—in other words complete recanalization of the deep veins had occurred in every instance. In 15 cases no abnormality could be identified on the venogram; in the other 11 a variable length of the deep circulation had been replaced by tortuous incompetent veins which communicated freely with the superficial system by means of incompetent communicating veins.

The author believes, on the basis of these studies, that there is no reason why any patient suffering from a varicose or postphlebitic ulcer should be denied the benefits of radical obliteration of superficial varices, since these

incompetent veins are not compensatory and must be hindering rather than helping an already hard-pressed deep circulation.

In those cases of postphlebitic ulceration in which the deep circulation appeared to be clinically abnormal and venographically normal, two alternative explanations present themselves. Either the deep circulation is normal, in which event the previous attack of deep thrombophlebitis presumably was confined to the veins of the pelvis, or the venogram only appears to be normal, and the deep circulation is actually abnormal in that the valves have been destroyed and the veins, although patent, are really incompetent. This could not be determined in the venograms made by the method described. If the deep veins are actually incompetent, one would expect some dilatation due to the pressure of the column of blood in the erect position; dilatation of the deep veins below the knee was actually present in 2 cases in this group. A review of all the venograms in both series (62 cases with ulceration and the 134 normal cases of Part I) disclosed 6 examples of such dilatation. The author concludes that the appearance of widening of the deep veins of the lower leg in a venogram may be within normal roentgenologic limits and should not necessarily be considered to indicate varicose degeneration of the deep circulation.

Retrograde venography was carried out in 23 normal cases to see if it would be of any assistance in the diagnosis of incompetence of the deep circulation. With the patient supine, the foot of the table was tilted down to an angle of 45° with the horizontal. This was done to insure that the valves were functioning and the cusps open. The femoral vein was then compressed against the superior ramus of the pubis, and 15 c.c. of diodone was injected into the vein in a retrograde direction, distal to that point. In 7 cases the opaque solution was held up at the first valve, there being practically no retrograde flow distal to that point. The vein above the valve could be seen to be distended owing to the pressure of the injection. In the remaining 16 cases, extensive retrograde flow occurred not only in the femoral vein but also in many of its large muscular branches, including the profunda femoris. Retrograde flow of the opaque medium, after retrograde injection, should therefore not be regarded as indicating incompetence of the valves of the deep circulation and should not be taken to be an indication for ligation of the popliteal vein.

Twenty-seven roentgenograms; 10 tables.

Arteriography in Two Cases of Malignant Tumors (Melanoma and Neurinoma). Torfinn Denstad. Acta radiol. **35**: 309–312, April 1951.

Arteriography has been most frequently utilized in the differential diagnosis of brain tumors. The presence of pathologic vessels carries with it the implication of a malignant lesion.

Two cases are presented. One patient had a metastatic malignant melanoma in the soft tissues of the thigh. The arteriogram showed the tumor to contain numerous small vessels of even caliber but irregular courses. In some portions of the tumor the opaque medium approached the appearance of a "tumor stain." In the second case a malignant neurinoma was present, just above the left kidney. Abdominal aortography showed that the tumor received its blood supply directly from the aorta and contained numerous vessels. Some of these were tortuous, with irregular courses and small caliber, and in some places there was dilatation of the vessels.

The author concludes that arteriography will give a rough conception of angio-architectural structures in tumors of the types described here.

Two roentgenograms. I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Percutaneous Arterial Catheterization in Dogs with Special Reference to Aortography. E. Converse Peirce, II. Ann. Surg. **133**: 544–547, April 1951.

To secure repeated roentgenologic records in a large series of aortic grafts in dogs, a simple and rapid method of catheterizing the aorta by way of the femoral artery was devised. The method consists simply in passing a small disposable polyethylene tube to the desired aortic level through a large hypodermic needle percutaneously inserted into either femoral artery. It has been possible to reach any portion of the aorta and to carry out periodic examination without sacrifice of an artery.

A position in the aorta below the arch may be reached blindly. For other positions, it is best to fill the catheter with 70 per cent diodrast and follow it fluoroscopically or by serial roentgenograms.

The method described has several advantages. The required equipment consists of standard items and is inexpensive. The method is easily learned, and with experience is not time-consuming. Since no "cut-down" is required, the femoral artery is not sacrificed. Any portion of the aorta may be reached, and repositioning is possible. Small doses of diodrast injected against the current of blood produce excellent visualization, and the examiner can be at a distance from the roentgen ray field while making the injection. The catheter may be left in place for hours, during which time it can be employed for serial blood samples, direct blood pressure determinations, roentgenography, or blood and drug therapy. Substitution of a very small cardiac catheter with a bent tip makes possible the cannulation of aortic branches such as the renal arteries.

Six illustrations, including 5 roentgenograms.

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MISCELLANEOUS

Effect of Focal Size, Shape and "Structure" on the Roentgenographic Representation of Small-Calibre Metal Objects. Arne Frantzell. Acta radiol. **35**: 265–276, April 1951.

Metallic objects of subfocal size will produce a penumbral shadow on a roentgenogram. In such a case, the roentgen image produced will be directly influenced by the size, shape, and structure of the focal spot. The author illustrates by example and by a formula the production of the penumbral shadow and shows the relationship of focal spot size, object size, and image produced. It is shown that the penumbral image obtained will be governed by factors of magnification much greater than would be expected by the usual laws of pin-hole photography. An object with a diameter of 0.05 mm. will produce a shadow forty times greater.

It is further demonstrated that as objects of subfocal size are brought nearer the mid-point between focal spot and film the image produced will gradually assume the shape of the focal spot.

Formulae for calculation of penumbral width, the calculation of critical distance with regard to object-

film distance, and for calculation of the resolving power of a pin-hole aperture are presented.

Eight roentgenograms; 2 diagrams; 1 chart.

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VA Hospital, Chamblee, Ga.

Clinical Study of Visceral Lesions and Endocrine Disturbances in Eight Cases of Diffuse Scleroderma. Javier Robles Gil. Ann. Int. Med. **34:** 862–871, April 1951.

Eight patients with diffuse scleroderma were studied. In two of the patients a complete endocrinologic study was not made, due to their critical condition. With these two exceptions, all were subjected to the following studies: complete blood count; determination of blood urea, uric acid, creatinine, glucose, cholesterol, calcium, phosphorus, phosphatase, potassium, sodium, chlorides, proteins, carotene, and ascorbic acid; Kahn, Wassermann, and Mazzini tests; glucose tolerance and Kepler tests; basal metabolic determinations; determinations of 17-ketosteroids and of follicle-stimulating hormone and estrogen excretion in urine. Radiologic studies of the chest, digestive tract, and bones and joints were also made, electrocardiograms taken, and skin biopsies performed. Results of the studies are summarized in tables.

In 7 cases, a diffuse scleroderma involved practically the entire body. One case after ten months of evolution of the sclerodermatous process showed lesions confined to the arms. In 7 cases, vascular phenomena of the Raynaud type appeared after or at the same time as the skin lesions; in 1 case they antedated the skin lesions.

In the majority of the patients, the radiologic study showed a dilatation of the esophagus, the stomach, and the small bowel. Radiologically demonstrable lesions of the small bowel were a striking feature. A decrease of the peristaltic movements was a constant finding. Occasionally cardiac or pyloric stenosis was observed. The mucosa of the stomach was hypertrophied in the fundus and atrophied at the antrum.

When enlargement of the heart was demonstrable, it was global, and the picture was similar to that of pericardial effusion. Radiologic changes in the lungs consisted of slight fibrosis in 4 cases. The bones and joints showed marked decalcification of the bony epiphysis in those places where the sclerodermatous process caused the greatest loss of joint mobility, as in the bones of the fingers. However, generalized decalcification was not present, as judged by the study of skulls, alveolar ridge, etc.

Hypoadrenalism was indicated by increased blood potassium, a positive Kepler test, low 17-ketosteroids, lymphocytosis, and disturbance of protein, cholesterol, and carbohydrate metabolism.

It is unquestionable that scleroderma attacks the entire mesenchymal tissue and may give rise to manifestations in any part of the body. The clinical picture in relation to the digestive tract most commonly found in advanced cases is a progressive dysphagia, with the sensation of a foreign body and a pseudo-obstructive intestinal syndrome, with colicky abdominal pain, abdominal distention, marked diminution of peristalsis, protracted constipation, malaise, and restlessness, all of which symptoms subside with bowel evacuation. Occasionally nausea and vomiting occur. These disorders are due to atrophy of the musculature of the digestive tract, secondary to hypertrophy of connective tissues, with disappearance or decrease of the peristaltic movements, and dilatation, more especially of loops of intestine. Prostigmine or large doses of vitamin B complex were ineffective in ameliorating the symptoms.

Enlargement of the heart is easily explained by the generalized hypertrophy of connective tissue, with myocardial atrophy and subsequent dilatation. Arterial hypotension was also found in most of the patients.

In the 8 cases studied in this paper, there were no clinical symptoms or laboratory data to suggest endocrine dysfunction other than hypoadrenalism.

Seven roentgenograms; 4 tables.

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Evansville, Ind.

Intestinal Gas in Radiology. M. Arias Bellini. Radiología (Panama) 1: 25, December 1950. (In Spanish)

For elimination of intestinal gas in the gallbladder and urinary tract radiography, the subcutaneous injection of 0.1 acetylcholine is advocated together with 5 international units of posterior pituitary lobe extract. The cholinergic actions of the two drugs augment each other, while the hypertensive effect of the one is counteracted by the other, and intense abdominal pains are avoided by the 50 per cent reduction in the dose of the pituitary extract. Blood-pressure readings before and after injection are tabulated in 10 cases, 9 of which showed elimination of the disturbing gas.

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Phantom Tumors of the Pelvis and a Case Report. William S. Goldfarb. New York State J. Med. **51:** 939–941, April 1, 1951.

Although the *Standard Nomenclature of Disease* includes phantom tumors under the diagnoses of hysteria and malingering, common usage defines these tumors as masses palpated bimanually but not felt on subsequent examination. The author's search of the literature uncovered no publications on this subject in the last twenty-five years.

Mistaken identity of a phantom tumor of the pelvis may result in unnecessary surgery, as in 3 cited cases which proved on operation not to be adnexal or uterine growths, but congenitally redundant loops of colon on long lipomatous mesenteries.

This group of vanishing tumors includes ovarian cysts that disappear by absorption or rupture, a full or incompletely emptied urinary bladder, redundant loops of colon, tumors on long pedicles in or outside the pelvis, and a pregnant uterus which undergoes diminution in size due to spontaneous resorption of a missed abortion. Differential diagnosis is discussed, and the importance of emptying the bladder and rectum prior to pelvic examination is stressed.

The author's case of a young woman with an evanescent left-sided pelvic mass and displacement of the pelvic viscera to the right and anteriorly proves the value of the barium enema examination in properly identifying a phantom tumor as merely a redundant loop of rectosigmoid. The possibility of an adnexal or uterine growth was excluded, and surgical exploration was avoided.

Two roentgenograms.

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RADIOTHERAPY

Place of Radiation in the Treatment of Intracranial Tumors. H. Dabney Kerr. Wisconsin M. J. **50**: 377–379, April 1951.

Tumors of the brain are primarily a neurosurgical problem. Not all, however, are curable by surgery and practically the only other procedure with any significant chance of success is radiation therapy.

The radiologist must have knowledge of the life history of the tumors and the relationship of differentiation to radiosensitivity. Anaplasia frequently, but not always, goes hand in hand with radiosensitivity.

Kernohan has added the concept of grading in the study of these tumors, and thereby put their treatment by radiation on a more logical basis. His classification recognizes five types, each graded 1 to 4: astrocytoma, ependymoma, oligodendroglioma, neuro-astrocytoma, medulloblastoma.

The fact that radiations are dangerous should be kept in mind. The author believes one is justified in causing damage to skin, bowel, bone or even an eye, but doubts the justification of brain damage even to save a life. Brain is relatively resistant but may be damaged by more than 5,000 or 6,000 r tissue dose.

Astrocytomas as a group are relatively resistant to radiation, though the less differentiated examples may be controlled for a matter of months.

Medulloblastomas cannot be cured by surgery, and irradiation should be given to the entire skull and spinal canal because of the possibility of gravitational metastasis in the cerebrospinal fluid.

Oligodendrogliomas, neuro-astrocytomas, and meningiomas are usually well differentiated and radioresistant.

Pinealomas usually respond to irradiation, though surgical means of reducing pressure may be indicated.

Ependymomas when well differentiated are a surgical problem, though with higher degrees of anaplasia they become more sensitive. One should irradiate the tumor and spinal subarachnoid space.

Pituitary tumors—acidophilic, chromophobic, and basophilic—are usually diagnosed because of (1) acromegaly or gigantism, with or without visual disturbances, (2) visual disturbances and hypopituitarism, and (3) symptoms of Cushing's basophilism, respectively. In 50 to 80 per cent of acidophilic tumors the sella turcica is enlarged. Basophilic adenomas are never large enough to lead to pressure symptoms, but produce symptoms by hormonal changes. With eosinophilic and chromophobic tumors treatment is principally to restore vision, and irradiation is the procedure of choice. Fifteen to 20 per cent of these tumors do not respond, as they are of cystic type, and in such cases surgery is indicated. Basophilic adenomas are radiosensitive.

Craniopharyngiomas, which are radioresistant, are sometimes difficult to differentiate from pituitary tumors. Evidence of calcification is practically pathognomonic of craniopharyngioma.

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Irradiation of the Pituitary in the Treatment of Malignant Exophthalmos. William H. Beierwaltes. J. Clin. Endocrinol. **11**: 512–530, May 1951.

In patients with malignant exophthalmos, a decrease in measurable protrusion of the eyes is rarely, if ever, brought about by lowering the basal metabolic rate when it is elevated, or by the administration of desiccated thyroid when it is not. Surgical decompression of the orbit is effective in this condition, but it is a relatively formidable procedure. McCullagh *et al.* (Tr. Am. A. Study Goiter, 1942–46, p. 15) believed that irradiation of the pituitary gland might be a rational approach to the treatment of malignant exophthalmos because of "evidence suggesting the pituitary might be a source, through its output of thyrotropic hormone, of both Graves' disease and exophthalmos," the known effect of x-rays on basophil tumors of the pituitary in Cushing's disease, and the decrease in size of certain other pituitary tumors as evidenced by relief of optic nerve compression.

At the University Hospital, Ann Arbor, Mich., irradiation of the pituitaries of 10 patients with malignant exophthalmos and 1 with obstinate progressive exophthalmos was carried out with encouraging results. Loss of vision was imminent in 10 patients, as evidenced by the progress of objective manifestations of malignant exophthalmos while under therapy with desiccated thyroid. Six patients were white; 3 of these were males. Of 4 colored patients, 1 was a male. The age range was from thirty-two to seventy-one years. The x-ray therapy was given to two temporal fields (8×7 cm.) and, in addition, in 2 patients to an anterior nasal field. A representative technic employed 200 kv., 25 ma., 50 cm. target-skin distance, filtration 0.5 mm. Cu plus 1 mm. Al, half-value layer 1.0 mm. Cu, 40 r per minute, 150 r measured in air to each field each day for a total of 700 r per field.

Nine of the 10 patients were treated before radiation with 0.1 gm. of desiccated thyroid, U.S.P., per day for an average control period of 10.7 months, ranging from 0.5 to 22 months. The average progression in exophthalmos during this period was +2.7 mm. O.D. and +1.1 mm. O.S. The average duration of follow-up with exophthalmometer measurements after radiation therapy was 13 months, with a range of 5 to 31 months. The average interval between radiation therapy and the beginning of recession in patients later enjoying a significant recession in exophthalmos, *i.e.*, 2 mm. or more, was 3 months, ranging from 0.7 to 5.0 months. The average interval between radiation therapy and maximum recorded recession of the eyes was 11.8 months, ranging from 3.5 to 24 months. Seven patients had significant recession in exophthalmos after radiation therapy, in either the right or left eye, or both. The average in the 6 patients with response O.D. was −5.7 mm. and in the 4 with response O.S. was −5.3 mm. The eyes of 3 patients showed no significant recession in exophthalmos. Only 1 of these patients had a significant increase in exophthalmos during the post-irradiation period. One patient showed a recurrence of eye protrusion after maximum recession had taken place.

Other factors conceivably influencing the response to irradiation were recorded. The average weight gain after irradiation was 13 pounds in the group with significant eye recession and 8 pounds in the unresponsive group. The decrease in the basal metabolic rate during the post-irradiation period was −2.1 per cent in the responsive group, and −21 per cent in the unresponsive group. This latter figure, however, is based on only 2 of the 3 patients.

It is emphasized that the x-ray ports overlapped some extra-ocular soft tissue. The resultant radiation to extra-ocular tissues might conceivably account for some or all of the beneficial effects observed, through decreasing the volume of extra-orbital tissues. Although this theoretical possibility warrants investigation, the fact remains that radiation applied to the areas described above was usually followed by improvement.

The only unpleasant effects of radiation therapy in this study were mild headaches for three to seven days after radiation in a few patients and transitory epilation over the temporal areas in all patients. All later had a satisfactory regrowth of hair. No symptoms or signs of hypopituitarism were observed.

Nine photographs; 2 photomicrographs; 6 charts.

Cancer of the Tongue. Leonardo Guzmán. Radiología (Panama) **1**: 9–24, December 1950. (In Spanish)

Of 13,073 patients observed up to December 1948 at the Instituto Nacional del Radium, Santiago de Chile, 130 suffered from cancer of the tongue, 111 men and 19 women; 53 of the group were fifty to sixty years old and 110 were between forty and seventy. In 120 patients oral hygiene was poor; 13 gave positive serologic reactions, while 10 more gave a history of previous syphilis. In only 16 cases, or 13.1 per cent, were lymph nodes not palpable. Only 4 tumors were less than 3 cm. in diameter. Histologically all were squamous-cell carcinomas except 2: a hemangio-endotheliosarcoma in a man of forty-two and a reticulo-endothelioma in a fourteen-year-old girl.

As to differential diagnosis, the author mentions tuberculous ulceration, pressure erosion from teeth, angioma, neurinoma, lymphogranuloma, and actinomycosis. He warns against antisyphilitic therapy without biopsy.

In the treatment of lingual cancer the ideas of the French school are followed, the dose ordinarily not exceeding 1 millicurie per each longitudinal centimeter of the focus. Radium needles of 2 cm. length (0.6 and 1.33 mg.) and of 4 cm. length (2.66 mg.) are used. As a total dose, not more than 35 millicuries destroyed are given, the needles being left in place for five to six days in vasculocellular lesions or as long as seven to nine days in the intermediary and prickle-cell tumors with few mitoses and much cornification.

The surgical removal of metastatic lymph nodes is described. In the postoperative treatment radium molds at 4 cm. distance are applied for a dose of 2.5 to 3 mcd. per square centimeter of the surface, in ten to twelve days, or roentgen therapy may be given. In order to avoid an excessive epithelitis and edema of the neck, and in view of the possible involvement of contralateral nodes, the author gives around 4,500 r over the side of the invaded nodes and the rest over the other side, up to 7,200 r, according to the thickness of the neck. If the base of the tongue is affected, surgery is usually not practicable and three instead of the usual two portals are employed.

Of the 130 patients of this series, 118 were observed more than two years; 111 receiving radiation therapy are considered for end-results. Of these, 54 (48.6 per cent) showed local cicatrization (as compared to 46.3 per cent at the Radium Institute of Paris); 29 per cent remained well more than four years and 19.3 per cent more than five years. Of 14 patients treated only by x-rays, 14.2 per cent remained well for more than five years. A group of private patients not considered in this article showed five-year healing in 20, or 47.5 per cent.

In conclusion, careful inspection and palpation, study of the lymphatic drainage, and biopsy including the mucosa are emphasized. An appreciable number of these cancers could be avoided by treatment of vitamin B deficiencies and syphilis, proper oral hygiene, and education of the public toward better care of apparently innocent lesions.

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Planning Technique for Roentgen Treatment of Carcinoma of the Oesophagus and Other Deep-Seated Tumours. Olov Dahl. Acta radiol. **35**: 250–256, April 1951.

The author describes in some detail his method of planning for roentgen therapy of deep-seated tumors. Emphasis is placed on the effects of changes in position with relation to subcutaneous fat pads, on the outline and shape of the thoracic cage and abdomen and, lastly, as a cause of displacement of the viscera and the tumor center in relation to each other and to the body wall. In order to obviate such changes, the author suggests the following technic:

The patient is placed in the position to be used in therapy and under fluoroscopic guidance metal markers are placed on the skin on each side directly lateral to the tumor center and on the ventral and dorsal midline overlying the tumor. The site of each metallic indicator is marked on the skin with a fast dye.

A plexiglass window with a cross etched in it is fitted into an opening in the center line of the therapy couch. A plumb bob is dropped so that it overlies the cross. The patient is then aligned on the couch so that the plumb bob is centered over the anterior skin mark, and the cross in the plexiglass sheet underlies the posterior skin mark (visualized by a mirror beneath the table). A narrow band of dental compound is then used to obtain a casting of the anterior surface of the body at the tumor level. The casting is used to make a paper outline; and upon this outline the proposed therapy fields are charted and beam direction decided upon. The reader is cautioned to use the same technic to outline posterior and lateral parts. Before each treatment, fluoroscopic control is obtained with the therapy apparatus, under suitable operating conditions, to ascertain that the central ray of the beam passes through the tumor center.

By this method the depth dose delivered may be more accurately determined.

Two diagrams.

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Management of Bone Tumors. Some Debatable Problems. Norman L. Higinbotham. S. Clin. North America **31**: 317–328, April 1951.

The most obvious fundamental deficiency in the bone tumor problem is a lack of a suitable classification of the tumors. The author prefers a modification of the Bone Sarcoma Registry classification:

Malignant	Benign
Osteogenic sarcoma	Osteoma Osteoid osteoma
Fibrosarcoma	Non-osteogenic fibroma Fibrous dysplasia
Primary chondrosarcoma	Chondroma

Secondary chondromyxosarcoma	Osteochondroma
	Chondroblastoma (Jaffe; Codman's tumor)
Malignant giant-cell tumor	Benign giant-cell tumor
Endothelioma (Ewing's sarcoma)	Cavernous angioma
Angiosarcoma	Plexiform angioma
Plasma-cell myeloma	
Reticulum-cell sarcoma of bone	
Liposarcoma of bone	

The most confusing situation revolves around the question of Ewing's sarcoma. Awaiting further research, the author chooses to regard it as a distinct clinical entity and prefers the designation of endothelioma (Ewing's sarcoma). Equally unsettled is the attitude towards reticulum-cell sarcoma of bone. However, after a review of 37 histologically proved cases at Memorial Hospital the author is convinced that this represents a real entity. It can be distinguished from bone involvement in generalized lymphosarcoma and it has a considerably better prospect for five-year recovery than other types of malignant bone tumor.

It is a grave error to institute treatment of any bone tumor without microscopic confirmation of the diagnosis. This is particularly true of Ewing's endothelioma, where a single dose of roentgen therapy before biopsy may so alter the tissue that the pathologist is unable to render a correct report. When the tentative diagnosis is a benign tumor (cyst, giant-cell tumor, central chondroma or osteochondroma), the open biopsy should aim at complete removal so that, if the diagnosis is sustained, the surgical procedure will serve the dual purpose of biopsy and treatment. On the other hand, if a malignant tumor is suspected, tissue from a representative area of the tumor should be submitted to the pathologist for examination. In many instances open biopsy can be avoided by the employment of aspiration biopsy, which has proved satisfactory in approximately 80 per cent of the author's cases.

It is important that the roentgenologist and the pathologist have all available information on each patient in order to evaluate their observations. It is then the function of the clinician to correlate all of the findings and to determine the appropriate treatment. It seems "reasonably true" that a correct diagnosis can be made in about 80 per cent of bone tumor cases on the clinical setting and roentgenograms alone, but most authorities agree that the microscopic findings are more reliable, particularly when interpreted by a pathologist experienced in the field of bone tumors. A rare exception might be made in the case of a bulky cartilaginous tumor which the roentgenologist reports as malignant but in which the pathologist can discover only benign chondroma. It is safe to regard these as malignant and treat them accordingly. The author cites one case in which hemipelvectomy was done for a large cartilaginous tumor of the ilium regarded as malignant by the roentgenologist. Serial sections of the entire tumor revealed only chondroma, but the patient died with pulmonary metastases twenty-six months after operation. On the other hand, if the microscopic examination reveals chondrosarcoma, the report should be regarded as correct despite a roentgenographic opinion of benign chondroma.

The plan of therapeutic action must be determined for each individual case. Some tumors are totally radioresistant and surgery alone is indicated. Some radiosensitive tumors are inaccessible to the surgeon and an excellent result may be anticipated from irradiation. In general, there are few instances where irradiation and surgery combined are indicated in the management of bone tumors.

Primary *reticulum-cell sarcoma* of bone is highly radiosensitive, with an encouraging degree of radiocurability. The primary method of treatment for this tumor is with roentgen rays and a tissue dose of 3,000 to 4,000 r is considered adequate provided the entire tumor receives this dose. *Endothelioma* of bone is similarly regarded as one for which irradiation is the procedure of choice, but the five-year survival rate is discouragingly low, 4.1 per cent. Coley's toxins may be given to these patients either before, in conjunction with, or after the prescribed roentgen therapy.

Osteogenic sarcoma, including fibrosarcoma and chondrosarcoma, is practically always a surgical problem and prompt amputation is usually indicated as soon as the diagnosis is established. Preoperative irradiation appears to have no beneficial effect.

Metastatic bone lesions are practically always an irradiation problem. However, an occasional case may be suitable for amputation, particularly if there has been a pathological fracture and a swollen useless extremity is a burden to the patient.

Benign bone tumors should almost invariably be considered for surgical removal rather than irradiation. The cortical tumors that grow outward from bone, including the osteomas, exostoses, and osteochondromas are notoriously radioresistant and wide surgical removal should always be practised. The central chondroma and chondroblastoma are also radioresistant and are preferably treated by surgical removal. Surgery is also recommended for unicameral bone cyst, non-osteogenic fibroma, angioma, and osteoid osteoma. The lesions of Hand-Schüller-Christian disease may well be treated by irradiation methods. The roentgenographic diagnosis is readily confirmed by aspiration biopsy and the small dose necessary to control the lesions (150 to 200 r every third or fourth day for three to five doses) will not have any serious effect on the normal bone. The solitary eosinophilic granuloma may be similarly treated.

There is considerable controversy about the treatment of giant-cell tumors. There is no doubt that excellent results are obtained by either method in the hands of experienced individuals but, once the diagnosis has been established, the method of treatment should be chosen and persisted in to its ultimate conclusions.

The paper concludes with a brief discussion of the relation of trauma to bone tumors and the medicolegal aspects involved.

Six roentgenograms; 2 photographs.

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Sarcoma of the Endometrium. James A. Corscaden. Am. J. Obst. & Gynec. 61: 743–752, April 1952.

Five cases are reported, representing the three types of endometrial tumor.

The first type, of which the author presents 3 cases, is spindle-cell sarcoma of the endometrial stroma. In 2 instances post-surgical recurrence responded strikingly to irradiation. Massive infiltration of the pelvis in one case, and of the retroperitoneal tissues in the other, disappeared completely and had not recurred after eight and eleven years, respectively. The third case was of the same histologic pattern and was treated surgically

with no postoperative irradiation. It is impossible to state whether all neoplasms of this cell type are malignant, but a large proportion of cases reported in the literature are ultimately fatal, as a result of slow progressive infiltration over as long a period as seventeen years. It would appear that radiation should be given where there is recurrence or uncertainty of the completeness of surgical removal.

The second type of tumor, illustrated by a single case, was endometrial sarcoma containing cartilage. If this was true cartilage and not a simple metaplasia, the tumor should be classed as a teratoma. It was limited to the endometrium and there had been no recurrence in the two years since pelvic irradiation.

The third type, so-called carcinosarcoma, is also represented by one case. The histologic picture of the stromal portion of the tumor was that of sarcoma, intermingled with typical adenocarcinoma, but only the latter metastasized to the vagina. This tumor should possibly be called adenocarcinoma of the endometrium with stromal hyperplasia.

Seven photomicrographs.

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Androgen Therapy in the Control of Pulmonary Metastasis from Adenocarcinoma of the Corpus Uteri. Report of a Case Benefited by Androgen Therapy. John H. Freed, Eugene P. Pendergrass, and John W. Carnwath. Am. J. Roentgenol. **65**: 596–602, April 1951.

A case of adenocarcinoma of the corpus uteri is reported in which extensive pulmonary metastases were caused to regress, without evidence of recurrence for six months, following a course of androgen therapy. To evaluate the effects of androgen therapy in endometrial carcinoma, the pulmonary metastases were treated solely with that hormone. The patient was not denied the accepted modes of treatment for the primary growth or advanced disease in the pelvis.

A 55-year-old white woman was admitted to the hospital in January 1949, approximately six months after onset of occasional vaginal spotting and following biopsy of a nodular mass on the posterior vaginal wall which revealed metastatic adenocarcinoma. Diagnosis of adenocarcinoma of the corpus uteri was established by dilatation and curettage of the uterus. Initial roentgenograms revealed multiple small, nodular, metastatic parenchymal lesions in the right lower lung field, with three or four scattered lesions elsewhere in the lungs. A single osteolytic lesion was noted in the lower half of the right tibia.

The primary pelvic disease was treated with combined intracavitary radium and external roentgen therapy. Roentgen therapy was delivered also to the lesion in the right tibia. Treatment of the pulmonary metastases was withheld, however, until the appearance of chest symptoms.

In June 1949 a dry hacking cough developed and another chest roentgenogram showed a marked increase in the number of parenchymal nodules. Treatment was therefore started with testosterone propionate, 100 mg. intramuscularly three times weekly. There was marked improvement; the patient was asymptomatic when seen in September 1949, and a chest film at that time showed a complete regression of the parenchymal lesions. She had received a total of 3,300 mg. of testosterone up to that date. In March 1950 a roentgenogram revealed two or three small nodular lesions in the right lower lung field which resembled early recurrent metastases, but the patient was still without symptoms. There was no evidence of healing of the fracture of the tibia.

The complete regression of the pulmonary metastases following androgen therapy suggests that a hormonal stimulus may have been present which was inhibited by the androgen. Though the mechanism of action remains obscure, the favorable effects achieved in this patient lend further support to the belief that some hormonal imbalance between the anterior pituitary, adrenal cortex, and ovary may play an important part in the genesis and growth of endometrial carcinoma.

It would appear, from this study, that androgen therapy may prove a useful addition to the already accepted modes of therapy—surgery and irradiation—in the treatment of advanced endometrial carcinoma.

Eight roentgenograms.

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Results of Treatment of Bladder Cancer by Radiotherapy. J. L. E. Millen. Brit. J. Urol. **22**: 430–433, December 1950.

During the period 1932 to the end of 1944, 382 patients suffering from cancer of the bladder were considered for radiotherapy at the Christie Hospital and Holt Radium Institute, Manchester, England. The great majority were referred from other hospitals, and many had been treated previously by other means. The results of treatment are presented in terms of the five-year survival, with a correction for cases lost to follow-up and for intercurrent deaths.

The prognosis was markedly worse when gross infiltration of the bladder wall had occurred. In 69 patients without gross infiltration treated by radon-seed implantation, the net five-year survival rate was 63 per cent, while in 48 patients with gross infiltration the survival rate was only 21 per cent. In 38 patients without gross infiltration treated by radical x-ray therapy the net five-year survival rate was 24 per cent, and in 77 patients with gross infiltration the survival rate was 7 per cent. No comparison between the relative values of radon and x-ray therapy can be drawn from these results, for the latter was employed in those advanced cases where the tumor extent was such as to preclude radon-seed implantation.

The results in the entire group of 382 patients are as follows:

	Number	Net Five-year Survival
Radon-seed implantation	117	45%
Radical deep x-ray therapy	115	12%
Other radical radiation methods	54	11%
Palliative x-ray therapy	36	0
Too advanced for treatment	60	0

Other "radical radiation methods" included treatment by radium-needle implantation, by a central radium source introduced into the bladder in a sorbo ball, and "contact" x-ray therapy. For those patients treated by needle implants and by "contact" therapy, radon-seed implantation would have been preferable. Those patients treated by a central radium source in a sorbo ball would now be treated by radical x-ray therapy.

Four tables.

Malignant Tumours of the Testicle. P. F. J. Hickinbotham. Brit. J. Urol. **22:** 87–102, June 1950.

Three main types of tumor of the testicle are recognized: (1) the adult embryoma, corresponding to the ovarian dermoid and almost invariably benign; (2) the embryoid, teratoid, or mixed tumor, the common teratoma of early adult life; (3) the seminoma or embryonal carcinoma.

During the period 1936–46, inclusive, 95 cases of testicular tumor were seen at the Birmingham United Hospitals (England): 48 seminomas (50.5 per cent), 39 teratomas (41.1 per cent), 1 mixed-cell sarcoma (1 per cent). Seven patients were not operated upon and a histologic diagnosis was not made. No instance of adult embryoma was encountered.

As with cancer in many other locations, there are three alternative methods of treatment: simple removal of the organ in which the tumor arises; a radical operation to include the lymphatic nodes; irradiation alone or combined with surgery.

Of the 27 teratoma patients followed for over five years, 17 received postoperative abdominal irradiation, commencing within three months of the date of operation. The survival rates in the irradiated and non-irradiated groups are as follows:

	Patients Irradiated (17)	Patients Not Irradiated (10)
After one year	11 survivors	4 survivors
After two years	9 survivors	2 survivors
After three years	8 survivors	2 survivors
After four years	8 survivors	1 survivor
After five years	8 survivors	0 survivors
Five-year rates	42.4 per cent	0.0 per cent

Of the patients who received irradiation, 4 were known to have metastases at the time of operation; these died after two, seven, and nine months, and six and a half years. None of the non-irradiated patients had clinical metastases at the time of operation.

Twenty-three of the patients with seminoma have been under observation for five years. Thirteen were irradiated and 10 were treated by surgery alone. Results in this group were as follows:

	Patients Irradiated (13)	Patients Not Irradiated (10)
After one year	11 survivors	8 survivors
After two years	7 survivors	8 survivors
After three years	6 survivors	7 survivors
After four years	6 survivors	6 survivors
After five years	6 survivors	6 survivors
Survival rates	46.2 per cent	60.0 per cent

Of the 13 irradiated patients with seminoma, 2 were known to have secondary lesions at the time of operation; 1 of them survived one year, and the other is still alive.

In the 23 patients with teratoma in whom metastases developed, the site of the first metastatic lesion to appear was as follows: chest, 10 cases; abdominal nodes, 8 cases; local recurrence in scrotum or groin, 5 cases. For 17 cases of seminoma with metastases, the site of the first lesion was: abdominal nodes, 8 cases; left supraclavicular nodes, 3 cases; local recurrence in scrotum or groin, 3 cases; chest, 2 cases; iliac nodule in line of cord, observed before operation, 1 case.

The relation of trauma and imperfect descent of the testicle to testicular neoplasms is discussed.

Malignant Disease of the Testis With Special Reference to Radiotherapy. T. M. Prossor. Brit. J. Surg. **38:** 473–481, April 1951.

Malignant tumors of the testis are not common but are of great importance to radiologists, since x-ray therapy plays the major part in treatment. The author simplifies the classification to (1) seminoma, (2) teratoma, and (3) chorionepithelioma.

Teratomas tend to occur between the ages of twenty and thirty and show a great variety in their appearance, both grossly and microscopically. Lung metastases are most common with teratomas, 54 per cent in this series as compared with 35 per cent for seminomas.

Seminomas are usually seen between the ages of thirty and forty and present a much more homogeneous appearance grossly and microscopically. A higher percentage of cure was obtained in seminoma, apparently because more were seen before metastasis had occurred.

Chorionepitheliomas are fortunately rare but practically uniformly fatal. Necrosis and hemorrhage are features of the gross sections.

Clinically the usual findings are (1) good general health and (2) hard painless (occasionally painful) swelling of one testis. At times symptoms referable to abdominal metastases appear before the testicular enlargement is noticed. The biological (Friedman, Aschheim-Zondek, etc.) tests may be done, but biopsy is contraindicated.

Simple orchiectomy followed by irradiation is the treatment of choice. Since the lymphatic drainage is to the iliac and para-aortic nodes, irradiation is directed to these areas. As high a dose as possible is given, since there is no sure way of predicting radiosensitivity. The prognosis depends, as in all malignant tumors, on the extent of the process when treatment is instituted.

The author's material from Westminster Hospital, London, is divided into two groups: (1) 147 cases receiving high-voltage roentgen therapy before there was any evidence of metastasis, *i.e.*, prophylactic irradiation; (2) 44 cases first seen with metastases in the para-aortic nodes or elsewhere. In all cases except those with an inoperable abdominal mass due to disease in a retained testis, surgical removal was carried out prior to irradiation. The remainder received only radiotherapy. The five-year survival rates are estimated, on the cases seen between 1930 and 1945. Of 48 patients with seminoma in the group without metastases, 32 (66 per cent, remained alive and symptom-free, while of 9 patients with teratoma, 5 (55 per cent) were living without symptoms. In the group with metastases when first seen, only 5 patients remained alive without evidence of disease (15 per cent).

Fourteen illustrations, including 4 roentgenograms; 1 table.

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Irradiation Treatment of Lymphoid Hyperplasia of the Nasopharynx. James B. Irwin. California Med. **74:** 198–201, March 1951.

Irradiation of the nasopharynx has become a widely used method of reducing excess lymphoid tissue. Beta, gamma, and roentgen rays have been used for this purpose. With the beta applicator, a very large and possibly dangerous amount of radiation is delivered at 1 mm. depth, while only 2 per cent of this amount reaches a depth of 10 mm. If gamma rays are used, 17 per cent of the amount delivered at 1 mm. reaches a depth of 10 mm. With x-rays, the distribution of the

radiation is more homogeneous and the intensity on the surface is relatively low when an adequate amount is delivered to the mid line in the nasopharynx.

When the different types of irradiation are examined, it is apparent that for a very small amount of lymphoid tissue immediately surrounding the eustachian orifice, the radium applicator would be most desirable if it could be properly placed. If a penetration of more than 2 or 3 mm. is desired, a filter of 0.5 mm. platinum should be used in preference to 0.3 mm. monel metal.

There are two methods for application of x-ray therapy. One is to direct the ray through the side of the face in such a way as to cross-fire on the nasopharynx. This occasionally produces a parotitis, which is temporary and not considered serious by most radiologists. The other method utilizes an intraoral cone aimed at the nasopharynx.

In choosing the kind of irradiation to be used, it is desirable to have an accurate knowledge of the amount and location of the lymphoid tissue present.

Recently there has been some difference of opinion as to the results obtained by irradiation.

Two roentgenograms; 1 chart; 3 tables.

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Pittsburgh, Penna.

Concerning the Treatment of Certain Post-Operative Cicatrices, Particularly Those Following Plastic Surgery. The Use of Roentgen and Radium Rays. E. Daubresse. J. belge de radiol. **34**: 343–348, 1951. (In French)

The author states that after surgical procedures involving exposed areas, especially the face, irradiation is used prophylactically to prevent hyperplasia of fibrous tissue. On the second or third day after operation, radium needles containing 2 mg. are placed 46 mm. from the skin surface along the line of future scarification. As a usual rule a forty-eight-hour treatment period gives a dose comparable to 0.2 or 0.3 millicuries destroyed per centimeter of the surface irradiated. The patient is then observed for a few weeks. If, in spite of the treatment, a small fibroblastic scar appears, this is touched lightly with carbon dioxide snow, followed by mild ointment application. In some cases, where a definite scar is formed, roentgen therapy is used. Either contact therapy or higher kilovoltage (up to 120 kv.) is employed, with varying filtration according to the thickness of tissue to be penetrated.

In patients who have not cooperated properly and who may present later a definite keloid type of scar, the following method is used; the cicatricial tissue is scarified. This is immediately followed by application of carbon dioxide snow, which is in turn followed by x-ray therapy totalling 500 to 800 r. In very large keloids irradiation up to 200 kv. filtered by 0.5 mm. of copper and aluminum may be used with total doses of 600 to 800 r and at times even 1,000 r.

CHARLES M. NICE, M.D.
University of Minnesota

Relapsing Panniculitis (Weber-Christian Disease). Review of Literature and Report of a Case Including Treatment with Cortisone. Charles R. Shuman. Arch. Int. Med. **87**: 669–681, May 1951.

A case of relapsing panniculitis (Weber-Christian disease) was followed over a period of twenty-one months, from onset until the patient's death. The illness was associated with widespread nodular involvement of the subcutaneous panniculus and high fever.

Remission was induced on one occasion for two months by roentgen therapy (200 r twice a week, for a total of 400 to 600 r to each area involved). Subsequent irradiation failed to alter the course of the disease. Cortisone therapy produced a normal temperature for five days.

A reduction of adrenal cortex function was suggested by the finding of low 17-ketosteroid excretion, positive reactions to Robinson-Power-Kepler tests, and failure of hyaluronidase inhibition after epinephrine administration. Hypocalcemic symptoms occurred during the course of the disease and responded to calcium and vitamin D therapy.

The relationship of relapsing panniculitis to other disease entities is briefly discussed.

Two photomicrographs.

New Techniques in Radium and Radon Therapy. Anthony Green and W. Alan Jennings. J. Faculty Radiologists **2**: 206–223, January 1951.

New methods for the application of both radium and radon to the treatment of malignant tumors have been developed at the Royal Northern Hospital, London.

The basis of the radium technic consists in the preparation and use of a number of small independent radium cells which can be inserted as required into hollow sheath needles of appropriate length. External stabilizer attachments make possible accurate reproduction in practice of previouly planned distribution of the needles.

The radon technic was evolved as a complement to the "stabilized" radium method. It employs radon seeds in chain form and is a compromise between rigid needles and independent loose seeds. The seed-chains are valuable where radium needles are difficult to use. The distribution obtained by the chains is usually superior to individual seeds. They have been found of value in old people where fixation of the tongue, especially toward the posterior third, is poorly tolerated. They are also suitable for other intrabuccal implants, as in the palate, cheek, and residue of growth in the tonsil after external irradiation. Recurrent subcutaneous nodules on the chest wall from breast carcinoma, after roentgen therapy, may be treated with minimal dosage to the skin. The flexible chains readily follow the undulations of the skin of the chest wall and lines of chains are easily implanted accurately parallel.

Fourteen roentgenograms; 4 photographs; 9 drawings.

A Flexible Indicator for Use in Connection with Radiation Therapy. Ove Mattsson. Acta radiol. **35**: 313–318, April 1951.

The author has devised a flexible indicator for purposes of exact anatomical localization in areas in which the skin surface is curved. It consists of a leather band, 4 × 15 cm., in which holes are drilled at 1.0-cm. intervals.

Lead shot are subsequently placed in the holes. The midway point of the indicator is marked by a lead ball slightly larger than the others. If two straps are desired, the central opaque object may be a cube or a pyramid. The leather straps with the lead shot may then be taped in an approximate manner to the curved surface in question, *e.g.*, the neck, and radiographs made.

These indicators have been found to facilitate the

work in connection with radiation therapy. They have proved to be particularly useful in the treatment of the hypopharynx, as they permit greater exactitude in directing the beams on the fields and in the calculation of the doses. The indicators have also been used in connection with the puncturing of intervertebral disks in the lumbar region.

The paper is illustrated by photographs, roentgenograms and drawings. I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

RADIOISOTOPES

Tracer Studies with Radioactive Phosphorus (P^{32}) on the Absorption of Cerebrospinal Fluid and the Problem of Hydrocephalus. John E. Adams. J. Neurosurg. **8**: 279–288, May 1951.

The uptake of radioactive phosphorus in the superior longitudinal sinus, following introduction into the ventricular system, was studied in dogs, in human subjects with normal cerebrospinal fluid dynamics, and in 6 hydrocephalic infants. Curves were obtained for the rate of uptake of the tracer in the superior longitudinal sinus, its disappearance from the ventricular system, and the amount of urinary excretion of the tracer for the first twenty-four hours following its injection.

In dogs, after a partial block of the aqueduct of Sylvius was produced, a lower level of radioactivity was observed in the blood of the superior longitudinal sinus than in the normal controls.

The uptake of radioactive phosphorus in the superior longitudinal sinus was studied in patients undergoing prefrontal lobotomy, whose absorptive processes were presumed to be normal. In some patients, the communicating veins extending from the surface of the cortex to a pacchionian granulation were ligated. It was found that there was an immediate drop in the activity of the blood obtained from the sinus immediately adjacent to the ligated communicating veins, whereas samples obtained simultaneously from the sinus farther posteriorly showed no alteration from the normal curve. It is suggested that the reason for the immediate drop in the activity adjacent to the ligation is that the absorption of the P^{32} occurs distal to the pacchionian granulation. It is probable that the absorption of P^{32} and cerebrospinal fluid occurs by a process of diffusion directly into the blood stream by way of the veins or capillaries of the pia arachnoid or cerebral tissue.

A decreased rate of uptake into the superior longitudinal sinus, as well as a decreased rate of disappearance from the ventricles, was found in 4 hydrocephalic infants accompanied by decreased twenty-four-hour urinary excretion. In 2 hydrocephalic infants, these values were entirely normal. The question arises whether the latter 2 cases may represent an overproduction of fluid as the cause for the hydrocephalus rather than a defect in the absorptive processes.

One roentgenogram; 1 photograph; 8 graphs; 1 table. HOWARD L. STEINBACH, M.D.
University of California

Effect on Bone Grafts of Radio-active Isotopes of Phosphorus. Richard T. Odell, C. Barber Mueller, and J. Albert Key. J. Bone & Joint Surg. **33-A**: 324–331, April 1951.

The uptake of P^{32} by bone grafts is apparently related to the surface area of the bone exposed to bathing by surrounding plasma or lymph. The greater uptake of P^{32} by one piece of bone rather than another, therefore, does not necessarily indicate probable viability.

In a study performed on 14 dogs, the authors measured the relative rates of phosphorus-ion exchange with autogenous, boiled, frozen, and merthiolate bank bone. After subcutaneous injection of the radioactive isotope, autogenous inlay grafts of bone showed a higher uptake than frozen or boiled donor bone. Likewise autogenous bone becomes more radioactive than frozen, boiled or merthiolate bank-bone, at two, three and four weeks after intramuscular placement. Studies on release of P^{32} by homogeneous normal and boiled bone, when used as an inlay graft in uninjected recipients, were unsatisfactory.

It is believed that the anoxia, low temperature, boiling and mercurial immersion probably alter the protein matrix of bone to such an extent as to deny access of perfusing solutions to the haversian canal system. This is proposed as explanation for the greater uptake by the autogenous bone over the treated specimens.

Four tables; 2 charts. JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Radioactive Iodine in the Treatment of Angina Pectoris. Charles C. Wolferth, Richard H. Chamberlain, and John J. Mead. Pennsylvania M. J. **54**: 352–358, April 1951.

The results of therapy in cardiovascular conditions are difficult to evaluate, and the only measurement of improvement in angina pectoris is the patient's statement of relief of pain.

It has long been known that anginal symptoms which sometimes occur in the course of hyperthyroidism will improve when thyroid overactivity decreases. This is true whether the decrease is accomplished by surgical or medical means, or occurs spontaneously.

Since the thyroid has a remarkable affinity for iodine, the radioactive isotope I^{131} has been used to irradiate the gland in cases of hyperthyroidism with good results. Because of this, it was decided to try this method in cases of cardiovascular disease that were considered hopeless. The first case treated was that of a 48-year-old teacher who had heart failure gradually developing over the course of about a year. He was very nervous and had hypertension, tachycardia, pulmonary congestion, enlargement of the liver, and marked edema of the extremities. Oxygen therapy, diuretics, salt-free diet, and full digitalization caused no improvement. Because of the hopelessness of his condition, 10 millicuries of I^{131} was administered. Three months later it was obvious that he had improved, and a second dose of 10 millicuries was given. Gradually fluid retention decreased, nervousness disappeared, and the patient was able to return to work. He continued to receive digitalis and to take a mercurial diuretic occasionally.

The present series consists of 28 euthyroid patients, all of whom had extremely severe anginal pain. In these cases 10 to 20 millicuries of I^{131} was given and in several instances the dose was repeated. Of the 28 patients, 10 are dead, although none of those dying

showed any ill effect from the radioactive iodine. Several, in fact, had less pain and fewer congestive symptoms. In the remaining 18 cases the results in 12 were judged good, 4 fair, and 2 unsatisfactory. Patients receiving radioactive iodine must be under strict supervision for the radiologic safety of others. The urine must be collected and assayed until it falls to the safe level of isotope content.

After treatment the blood cholesterol rises even though no symptom of hypothyroidism makes its appearance. A few of the more than 70 patients that have now been treated have exhibited signs of myxedema and are being given small doses of desiccated thyroid.

The authors have used tracer doses for a rough estimate of what the radioactive drug will accomplish and they gauge the amount of the dose somewhat on the measurement of thyroid activity as shown by the tracer dose. JOSEPH T. DANZER, M.D.
Oil City, Penna.

Measurement of Blood Flow by the Local Clearance of Radioactive Sodium. H. Miller and G. M. Wilson. Brit. Heart J. **13**: 227–232, April 1951.

Radioactive sodium in isotonic sodium chloride solution was injected intramuscularly, intradermally, and subcutaneously in man, and the decline in the counts recorded by a Geiger-Müller counter was followed under various conditions influencing the circulation. The aim of the authors was to determine how accurate such a measurement of the circulation would be.

When the arterial circulation was obstructed by a tourniquet there was no fall in the count, but a rapid decline followed release of the tourniquet, indicating an increased rate of clearance.

Vasodilatation caused by indirect heating of the skin surface did not increase the rate of removal, but reflex vasoconstriction caused a slowing of clearance. Intravenous adrenalin did not alter the rate of removal of intramuscularly injected radiosodium.

The authors conclude from the foregoing observations that it is very doubtful if the measurement of local clearance of radiosodium is a sufficiently sensitive method for obtaining information regarding the blood flow in pathological states of the limbs or in deeper organs where no alternative method is available for comparison.

Four graphs; 2 tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

EFFECTS OF RADIATION

Prevention of Injury from X-Radiation. Francis R. Holden, Eugene Tochilin, Charles H. Hine, and Leon Lewis. California Med. **74**: 188–192, March 1951.

Radiologists have been shown by biostatistical evidence to be inadequately protected. Even the most modern equipment is insufficiently shielded. A maximum allowable exposure of 0.3 rem (roentgen-equivalent-man) per week is now accepted by the Atomic Energy Commission and the National Bureau of Standards. In January 1950, the State of California adopted safety orders establishing minimum standards applicable to all employments and places of employment for protection against radiation and radioactivity. Monitoring of personnel is required, and permanent records of inspections must be kept.

Personnel exposed to radiation may be monitored by either pocket dosimeters of the ion chamber or electroscope type or by properly standardized film badge dosimeters. Film badge dosimeters of the type permitting quantitative measurement provide the most suitable means for continuous monitoring of exposed personnel.

Central agencies properly equipped to serve radiologists and other users of radiation may best establish rigidly standardized technics of film development and interpretation. If the greatest possible information is to be obtained from film badge dosimeters, such technics are essential. C. R. PERRYMAN, M.D.
Pittsburgh, Penna.

Changes in Composition of Blood Plasma of the Rat During Acute Radiation Syndrome, and Their Partial Mitigation by Dibenamine and Cortin. Henry I. Kohn, with the technical assistance of Nancy Swingley, William Robertson, Marian Kirslis, Eschol A. Ledford, Germaine Click, and John Lane. Am. J. Physiol. **165**: 27–42, April 1, 1951.

Adult rats of four strains were irradiated on a presdwood "scatter block," receiving doses (estimated at a depth of half way through the trunk) of 100 to 125 r, 350 to 400 r, and 600 to 725 r, at the rate of 50 r per minute (250 kv., 15 ma., h.v.l. 0.4 mm. Cu, 100 cm. distance). While the magnitude of the changes induced varied slightly with the x-ray dose, the timing and sequence did not. The LD 50 for the four strains ranged from 650 to 770 r. At various intervals following irradiation the blood plasma was examined with reference to glucose, inorganic phosphorus, non-protein nitrogen, chloride, total protein, albumin-globulin ratio, total lipid and phospholipid, and cholesterol. In addition, the effect of dibenamine and cortin on the plasma changes was studied.

Glucose: A rise, the magnitude and duration (two to four days) of which depended upon the dosage, was followed by a return to normal levels. The greatest hyperglycemia occurred in those animals which refused to eat following irradiation.

Inorganic Phosphorus: A small rise occurred which approximately paralleled the hyperglycemia; again, the magnitude and duration of the change were proportional to dosage.

Non-protein Nitrogen: A small abrupt rise occurred, proportional to the dosage, lasting two or three days and followed by a return to normal. It is suggested that the glucogenesis necessary for the maintenance of an elevated glucose level during the period of radiation-induced starvation was an important if not the chief factor here.

Chloride: The pattern involved three phases: first, a small drop on the first and second days following irradiation; second, an abrupt rise on the next two days, subsequently maintained for three to ten days; third, an abrupt return to normal or approximately normal. The incisive timing, almost completely independent of dosage, suggested predominant control by an integrative mechanism and not by a gradually developing primary injury. In more than twenty experiments the typical pattern failed to occur but once.

Total Protein: Unlike glucose and non-protein nitrogen, total protein fell after irradiation, as it also did during starvation.

Albumin-Globulin Ratio: A rise in the albumin-globulin ratio was observed. At exposures below 500 r this effect was predominant on the first day only. Within the range of 600 to 900 r, however, the maximum was reached on the fourth day and in some cases elevation was noted for more than thirty days. It was the most enduring change found.

Total Lipid and Phospholipid: The total lipid showed a rise which roughly paralleled the change in the albumin-globulin ratio. The phospholipid was unchanged by irradiation.

Cholesterol: The cholesterol level varies under the influence of several genetic factors so that both "high" and low levels were found normally in the strains studied. In the 2 strains in which determinations were made, the level rose two to three days after exposure, reaching a maximum on the fourth day and returning to normal directly or after several days of subnormality.

Effect of Therapy: The changes in chloride and cholesterol were found to be prevented by daily administration of desoxycorticosterone acetate, or a lipoadrenal extract. Dibenamine and 2-dibenzylaminoethanol prevented the change in cholesterol alone. Injection of sheep erythrocytes one week before irradiation prevented the rise in albumin-globulin ratio.

It is proposed that radiation effects be classified as primary when occurring within cells directly injured and secondary when occurring in other cells. The effects reported are considered to be secondary, with the possible exception of the change in the albumin-globulin ratio.

Six charts; 5 tables. S. F. THOMAS, M.D.
Palo Alto, Calif.

Effect of Immaturity, Hypophysectomy and Adrenalectomy Upon Changes in Blood Plasma of Rat During Acute Radiation Syndrome. Henry I. Kohn, with the technical assistance of Nancy Swingley, W. J. Robertson, and Marian Kirslis. Am. J. Physiol. **165:** 43–56, April 1, 1951.

In this paper, which is a sequel to the one abstracted above, the author reports studies on the effect of immaturity, hypophysectomy and adrenalectomy on the plasma changes in rats following irradiation. In general the reaction was the same in the immature as in the mature rats, though the LD 50 for the younger animals was lower. Hypophysectomy shortened the period of hyperglycemia, reduced the rise in non-protein nitrogen, and prevented a rise in chloride in the immature group. In adult animals it had a similar effect upon the glucose and non-protein nitrogen reactions and produced some modification in the cholesterol reaction. No effect upon the protein and albumin-globulin reaction was observed in either group. Fasting did not affect the non-protein nitrogen level of the hypophysectomized mature animal, although it caused a fall in the normal and in the hypophysectomized immature animal. In the adrenalectomized mature animal, the glucose and non-protein nitrogen reactions to irradiation were greatly diminished, the chloride reaction modified, and the cholesterol, protein and albumin-globulin reactions unchanged or somewhat enhanced. Irradiation of the head and neck alone led to no changes in the plasma. Whatever role the pituitary or thyroid glands played was therefore an indirect one. A second exposure of the Holtzman strain to 650 r thirteen days after the first exposure did not elicit the non-protein nitrogen, cholesterol, or chloride reactions. The glucose reaction was diminished, but the protein and albumin-globulin reactions occurred as usual.

Taking these observations in connection with those reported in the earlier paper, the author reachs the following conclusions: The initial rise of the glucose reaction was independent of the pituitary-adrenal system, but the maintenance of the reaction was not. The non-protein nitrogen reaction was probably due to increased gluconeogenesis. The chloride reaction in the immature animal involved the pituitary. In the mature animal, however, the most important factor in the chloride reaction lay outside the pituitary-adrenal mechanism, and was antagonized by cortical hormones. The cholesterol reaction depended primarily upon a factor outside the pituitary-adrenal mechanism which was antagonized by the cortical hormones, dibenamine, and 2-dibenzylaminoethanol. The protein and albumin-globulin reactions differed from the preceding four in most of their characteristics.

Eight tables. S. F. THOMAS, M.D.
Palo Alto, Calif.

Experimental Studies on Early Lens Changes After Roentgen Irradiation. II. Exchange and Penetration of Radioactive Indicators (Na^{24}, K^{42}, I^{131}, P^{32}) in Normal and Irradiated Lenses of Rabbits. Ludwig von Sallmann and Beatrice D. Locke. Arch. Ophth. **45:** 431–444, April 1951.

In Part I of this study (Arch. Ophth. **45:** 149, 1951. Abst. in Radiology **57:** 925, 1951) von Sallmann describes the morphological and cytochemical changes in the lens after roentgen irradiation. In the second part of the study radioactive tracers were employed to investigate the effect of roentgen irradiation on the permeability of the lens and of the blood-aqueous barrier as far as it could be deduced from this order of experiment According to many workers, changes in the permeability of phase boundaries may play an important part in the pathogenesis of roentgen ray cataract. It is widely held, moreover, that the biologic actions of ionizing radiations are based partly or entirely on alterations in the selective permeability of the cell membrane. These changes can influence the rate of entrance of substances into the cells, and of their elimination, and thus may modify metabolic and synthetic processes. No extensive investigations on the eye have been carried out previously to support or disprove this theory.

Two experimental technics, each in part supplementary to the other, were followed. The specific activities of the labeled substances were determined in body fluids and digests of the lens by means of the Geiger-Müller counter or by an autoradiographic procedure which, when combined with a densitometric method, also allowed quantitative estimations to be made.

In general, the right eye of each of a group of young rabbits (57 experiments) was irradiated with 2,000 or 1,500 r. The radiation factors were the same as in the first study. Radioactive material was introduced by the intraperitoneal route at stated intervals prior to enucleation. The directly irradiated and the control eyes were removed at periods varying from two to eight weeks after irradiation, or later when cataractous changes were advanced.

The experiments with radiosodium confirmed the results of earlier studies with other indicators by demon-

strating an increased permeability of the blood-aqueous barrier up to six weeks after irradiation of the rabbit's eye with 2,000 r, but this phenomenon did not appear to play an integral part in the pathogenesis of radiation cataract.

The uptake of radiosodium by lenses with radiation cataract was greater than the uptake by control lenses. It increased with the progress of the cataractous process, probably in connection with the development of an extracellular phase in the damaged lens.

Radiopotassium penetrated rapidly into the normal lens. Four hours after intraperitoneal introduction of the labeled element, the ratio of specific activities of the anterior cortical layers and of the aqueous humor was greater than 1.

The accumulation of radioiodine in irradiated lenses with initial cataractous changes exceeded the accumulation in normal lenses and suggested an increased permeability of the damaged lens for this indicator.

Radiophosphorus accumulated in normal lenses principally at the equator and in the surface layers of the cortex. The autographic pattern expressed the higher metabolic rate of these parts of the lens. The difference between the superficial cortical and the deeper portions vanished in lenses with total radiation cataract.

The results of these experiments do not lend support to the theory that enhanced permeability of the lens or depressed processes of phosphorylation lead to the development of lenticular opacities produced by roentgen rays but suggest rather that these changes accompany, and possibly influence, the progress of the opacification.

Six radioautographs; 7 tables.

Pathology of Ionizing Radiation. Elbert de Coursey. Minnesota Med. **34:** 313–318, April 1951.

This is another rather condensed presentation of the effects of ionizing radiation based on the work of many investigators in connection with the atomic bombing at Nagasaki and Hiroshima. The author summarizes his observations as follows: The lymphoid and hematopoietic tissues, skin, genital organs, and gastro-intestinal tract were most severely affected by ionizing radiation. There was atrophy of lymphoid elements in lymph nodes, tonsils, spleen, and gastro-intestinal tract. Atrophy of the bone marrow was evident early, and it either continued or was followed by focal or diffuse hyperplasia with maturation arrest. Necrotizing inflammation of the oropharynx was prominent but limited to the third to sixth weeks. The scalp showed the surest external gross sign of ionization—alopecia, which, with hemorrhagic manifestations, appeared about the same time as the throat lesions.

The testes showed prominent microscopic changes, with almost every sex cell destroyed in all men who died. The ovaries showed very little more than extreme scarcity of proliferating follicles. In all time periods the intestinal mucosa was the seat of changes which varied from ulcerated hemorrhagic foci to focal or widespread necrosis and ulceration with formation of diphtheritic membranes.

The Physician's Problem in Atomic Warfare. James P. Cooney. J. A. M. A. **145:** 634–636, March 3, 1951.

The peculiarities and relative importance of the various effects of an atomic explosion should be made clear to everyone connected with civilian defense and especially to physicians.

In an air burst there are direct and indirect blast effects, of which the indirect are far more important. The indirect effect is due to the terrific air movements which cause glass, timber, and other debris to fly through the air. The relative unimportance of the direct blast effect is shown by the fact that in Japan, among those who survived, the only injuries in this category were less than 200 ruptured ear drums. In an underwater burst the blast effects would be confined to those fairly close to the explosion and flying debris would not be a problem.

Fires started by an air burst (broken gas mains, oil tanks, etc.) and fed by the winds created are an important source of casualties. No matter what the preparations are, fire fighting will be extremely difficult because of broken water mains and blockage of streets with debris. Many burn casualties are caused by the burst of infra-red rays from the explosion itself. Light-colored clothing will reflect these rays; the burns are thus mainly on exposed parts. It was first thought that flash burns occurred almost instantaneously, but recent evidence indicates that the infrared rays are emitted over a period of three seconds, giving a little time to seek shelter. No flash burns occur with an underwater burst.

As regards radioactivity, there are a number of important facts to remember. First of all, the direct radiation is emitted for about one and one-half minutes in an air burst, the most important reason for seeking shelter behind some substantial structure. The median lethal dose of gamma radiation (fatal to 50 per cent of those receiving it) of 450 r is delivered at a distance of 4,000 feet. At 6,000 feet the gamma dose is about 20 r. A small amount of heavy metallic substance (copper, gold, etc.) becomes mildly radioactive after an air burst, but this is not a significant hazard. After the initial one and one-half minutes, rescue teams may safely enter the bombed area in an air burst.

With an underwater burst, radiation assumes much greater importance, since the radioactive fission products rise and disperse with the cloud and fall over a wide area. Actually in an underwater blast nearly all the casualties would be caused by radiation.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

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